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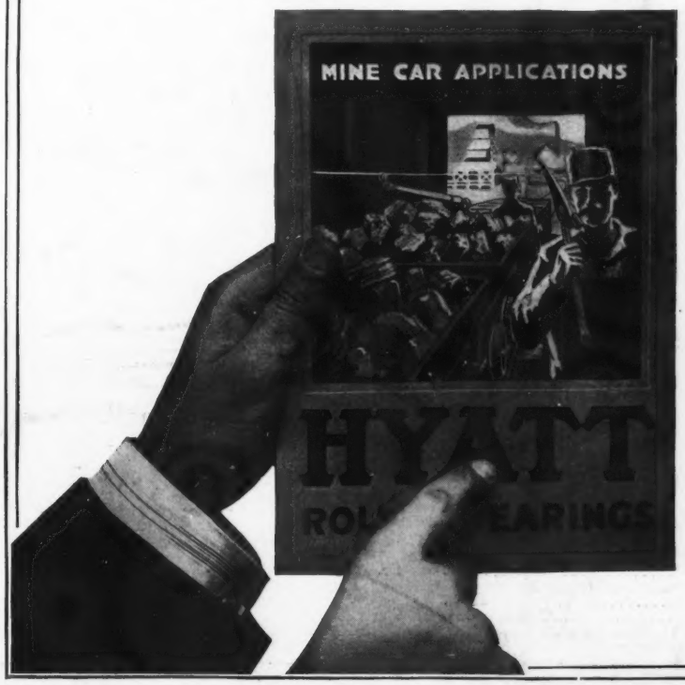

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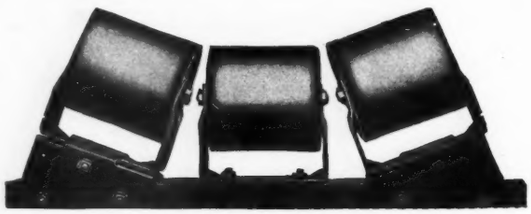

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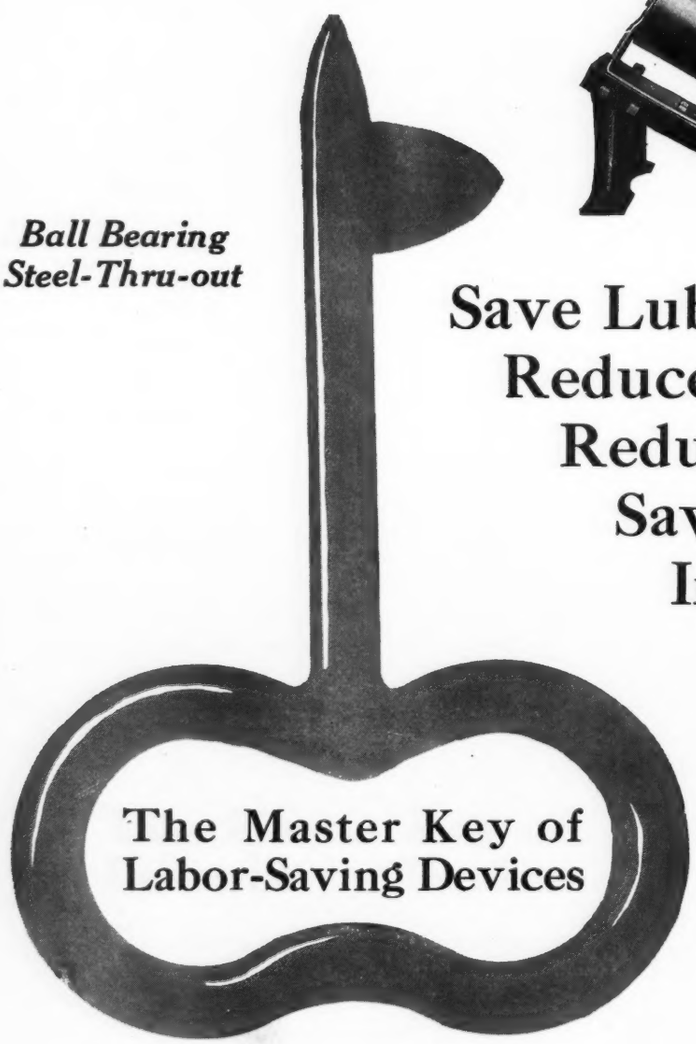

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Engineering and Mining Journal

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A Trip Through Honduras

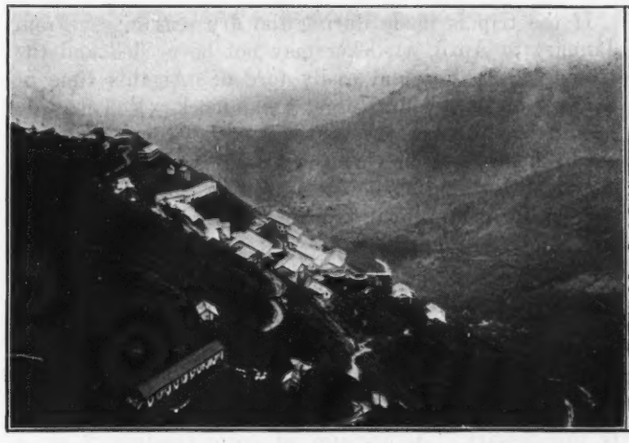
By D. McBride*

SYNOPSIS—Country may be entered from either coast, with part of the journey by automobile or train. Interior districts accessible only by mule-back, and outfit should conform to such conditions. Best route for mining men to see country is via Puerto Cortez, railroad to Potrerillos, thence by mule trails. Mining resources comparatively undeveloped. New York & Honduras Rosario the principal operation, producing about $100,000 in silver and gold per month. Lack of transport facilities retards other mineral development.

Having occasion to make a trip through the Republic of Honduras, C. A., I sought information on the subject of traveling in that country, but was unable to find anything of practical value. For the guidance of others similarly placed I offer these notes on a trip made last summer.

While it is possible to travel through Honduras without having a knowledge of Spanish, it cannot be recommended. At the larger coast towns like Puerto Cortez and Tela and on the railroad a great deal of English is spoken, but in the interior, practically none. As in many Latin-American countries, the foreigner who does not speak Spanish is a mark for the jesting and easy-money making proclivities of the natives; it seems as if "soak the gringo" were the slogan whenever a foreigner appears. Hence to anyone contemplating an extended trip or residence in the country, a slight knowledge of Spanish is a necessity.

Honduras may be entered from the Pacific coast through the port of Amapala, there being a service of steamships from San Francisco. Since the outbreak of the European War this service has been irregular, but there are steamers at two- to four-week intervals. If one's destination be the capital, Tegucigalpa, and comfort of traveling be an important consideration, then this would be the best route, as the inland journey to Tegucigalpa is made in two comparatively easy stages—a short trip in a gasoline launch to San Lorenzo and from this place to the capital in automobile. At San Lorenzo one can find a good hotel and meals and at Sabana Grande a short stop is made, about noon, for lunch. The automobile trip costs 30 to 35 pesos ($12 to $14 U. S. currency) per person, which includes a moderate amount of luggage.



PLANT OF N. Y. & HONDURAS ROSARIO MINING CO., AT SAN JUANCITO, HONDURAS, C. A.

REST-STATION AND FARMING SETTLEMENT AT PROTECCION, HONDURAS, C. A.

Automobiles can be hired at San Lorenzo or from Tegucigalpa, by the hour or for the trip. The tariff is variable, and an agreement should be reached before hiring.

The journey from the coast to the capital occupies one day, and despite the fact that the road is bad and one is jolted about mercilessly, it is a most interesting ride. From the eastern United States one can take advantage of this short cut to the capital by taking the United Fruit Co.'s steamer to Puerto Barrios, Guatemala; thence by rail to the Pacific port of San José and by steamer to Amapala. In traveling by this route one should stop over at Guatemala City until the steamer is nearly due at San José, as this latter port, like most Pacific-coast ports,

*Mineral Point Zinc Co., Depue, Ill.

is hot and mosquito-infested, and good accommodations are unobtainable. It is also possible to travel from eastern United States to Colon by steamer, across to Panama, then by Pacific Mail to Amapala. While such a roundabout route involves more time and expense, it offers many attractions of an educational nature.

To the mining man who wishes to see something of the country, the best route is undoubtedly that through Puerto Cortez. The United Fruit Co. has a weekly service from New Orleans to Puerto Cortez, the steamers being comfortable and the food and service good. The fare is $35. From New York one could take the United Fruit Co.'s steamer to Puerto Cortez, the fare being $100; but traveling by rail to New Orleans (fare and Pullman cost $39.55), leaving Pennsylvania Station, New York, at 4:35 p.m. Tuesday, one arrives in New Orleans on Thursday morning. The steamer sails at 11 o'clock Thursday forenoon and arrives at Puerto Cortez the following Wednesday. From New Orleans there is also the Hubbard, Zemurray Line, the fare being $30. While not catering especially to the passenger trade and therefore not so comfortable as the United Fruit steamers, yet they are good.

Outfitting and General Advice

In outfitting for a trip through Honduras it should be remembered that all travel in the interior is by muleback and that all the trails are bad. The pack for an animal should not exceed 200 lb. and should be divided in two pieces of equal size and weight. Steamer cabin trunks not over 33 in. long are best, and it is a good thing, especially in the wet season, to take a piece of canvas or oilcloth large enough to cover the entire pack. One blanket, a hammock, soap, towel and razor should be wrapped together in oilcloth and this, along with the provision sack, should be placed on top so as to be accessible without disturbing the pack. In the wet season a pommel slicker is indispensable. Only light-weight clothing should be taken. Khaki is most serviceable. Boots are preferable to leggings as they keep one's feet dry in crossing rivers and withstand the rough trail if one does any walking. An occasional walk down hill rests both rider and animal. Pullman drinking envelopes are more convenient than a drinking cup.[1]

In Puerto Cortez there are two hotels that can be recommended—the Laferbre, the oldest, and the Palm. The latter is quieter, cleaner and the food is good. The charges are the same—six pesos per day.

Upon entering Honduras the customs authorities examine one's luggage, but usually this examination is perfunctory. Also an immigration tax of one peso per person and 25 centavos for each piece of baggage is charged. There is no transfer service, but there are men on the dock who will take the luggage to the hotel, unloading it on the way at the customs house. A bargain should be made before allowing the luggage to be removed, the usual charge being one peso per trunk and 50 centavos for a suit case.

From Puerto Cortez one may telegraph to Tegucigalpa for mules to be sent to Potrerillos, the terminus of the railroad, or may take the chance of hiring mules at Potrerillos on arrival there. The rate from Potrerillos to Tegucigalpa is about 30 pesos per mule plus 30 pesos for a *mozo*, and it is the same whether one hires them at Potrerillos or by telegraph from Tegucigalpa. The largest mule-hiring agency in Tegucigalpa is that of Jersey Brooks. On leaving Puerto Cortez, enough canned goods to last for, say, about seven meals should be taken. Sardines (with keys) are good, also preserves in small cans, enough for one meal, and a tablet or two of plain chocolate. A large assortment of canned goods is available at Puerto Cortez, and this is the best place to stock up on them, as farther inland they are scarce and cost more. Some travelers take crackers, but it will be found better to buy bread enough for two days at a time; as it is more satisfying and less bulky.

Before leaving the port one should obtain enough silver money to cover all expenses on the trail, as no bills are accepted outside of the large towns. Pesos, tostones (50 centavos) and pesetas (25 centavos) are accepted everywhere, and from Potrerillos to Miambar one-real pieces (12½ centavos) are accepted. From Miambar onward 10 centavo pieces of Nicaragua and two-centavo coppers of Honduras pass. The expenses on the trail will run from 35 to 50 pesos, not including hire of mules and *mozo*. The train from Puerto Cortez to Potrerillos leaves on Monday, Wednesday, Friday and Sunday mornings and generally arrives at Potrerillos about three or four o'clock. The fare is 4.75 pesos. Usually the train stops long enough at San Pedro Sula for one to go up town and have lunch. Arrived at Potrerillos, the traveler will find but one hotel, and as likely as not he will have to share his room with a fellow tourist. The meals are fair as a rule, though one notices that more in coming in from the trail that when starting out. Rates are about 3 pesos a day.

If the trip is made during the dry season, say from January to April, a slicker may not be needed and the rivers will be low and easily forded. At this time of the year on no account forget a hammock. You may do so and live through the journey in the wet season, but not in the dry season, when the tenacious and omnipresent *garrapata* is doing business. If you are so unlucky as to have an intimate acquaintance with this tick forced upon you, apply the glowing end of a cigarette to his person; he will thus give up the ghost with little trouble to yourself, but if you forcibly detach him he will leave behind a souvenir that will keep you in misery for two or three weeks. It will pay to look into the feeding of the animals on the trail, as the natives appear to think that anything beyond what the mules can find by grazing at night is unnecessary. A measure of corn (costing 2 or 3 reales) each morning while saddling will make quite a difference in the endurance of the animals. The cost of hire of mules includes pasturage (*potrero*) on the way.

Route from Potrerillos to Tegucigalpa

The first day's journey from Potrerillos to Tegucigalpa is one of 10 leagues to Santa Cruz through flat country infested with mosquitoes and with little shade from a scorching sun. Arrived at Santa Cruz, one can find two places where travelers are provided with bed and board in return for 3.50 to 4 pesos a night. Here also there is a store where a fair selection of canned goods is on hand. Bread can be had as a rule, though it should be remembered that at no place can one be sure of getting it.

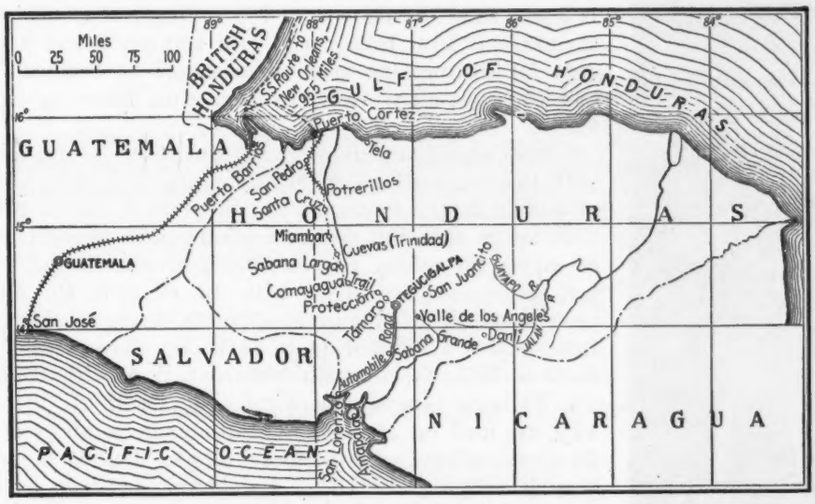
From Santa Cruz to Miambar, another 10 leagues, constitutes the second day's journey, and the trail is hilly and

[1]The point regarding boots is debatable. For a drinking cup, many tropical prospectors carry a large horn spoon on a rawhide loop, hung on the pommel of the saddle.—Editor.

much broken up. There is no inn or hotel now before Comayagua is reached, so the traveler has to stay at some house where he slings a hammock and sleeps as well as he may. From Miambar to Cuevas (sometimes called Trinidad) is four leagues, and many make this their stopping place for the day, but one can go on to Sabana Larga, making the day's journey eighteen leagues.

The third day's journey is to Comayagua, a distance of 10 leagues from Cuevas or six leagues from Sabana Larga. Of the 10 leagues about two are flat and the remainder hilly. In the wet season the River Omuya (sometimes called the Comayagua as it goes near the town of that name) will have to be crossed in a canoe. The boatman lives in a house commanding a view of the trail and appears on the scene when the traveler reaches the bank of the river. Pack, saddles, etc., are taken in the canoe, and the animals swim across. The charge when the river is low is two reales for each person, pack or animal, and when the river is high, double that amount.

At Comayagua the traveler finds the first town since leaving San Pedro Sula, and if he seeks diligently, he



OUTLINE MAP OF HONDURAS, SHOWING ROUTES FROM COAST PORTS TO CAPITAL

will find lots of stores of various kinds. There are two hotels, the lesser evil of the two being the New York. Four or five pesos per day is charged, but I have heard of an American who could not speak Spanish being held up for 10 pesos and only being saved through the intervention of his *mozo*. For putting on two horseshoes, the shoes *not* included, the local blacksmith wanted three pesos. If one has any work of that kind, it is better to let the *mozo* get it done; for the sight of a gringo is enough to dissipate any little sense of commercial decency that the native may possess. Speaking of horseshoes, it would seem to be a good thing to take a few horseshoe nails along, for blacksmiths are scarce and an animal without a shoe soon goes lame traveling over the stony trails which are the usual thing in Honduras.

The end of the fourth day should find one in Protección, distant 12 leagues from Comayagua, the first six of which lie in the valley of Comayagua and are quite flat and the latter six mostly uphill over a twisting, rocky trail. At Protección one can always find a place to sleep and something to eat.

The fifth day's journey takes one into Tegucigalpa, another 12 leagues, four of which are flat and the rest hilly. On the way the *mozo* will be sure to point out the rock from which the bandits shot at the gringo some two years ago. The result of the shooting was 2—0 in favor of the gringo. A year before that another gringo was attacked not far from the same place, but he was badly wounded; his *mozo,* however, escaped with the pack (which was the real object of the attack) and then returned and brought the injured man to a house. Since that time soldiers pass over the trail at frequent intervals. It should also be noted that the trail from Tegucigalpa to and including Támaro has the reputation of being unsafe for the pasturing of animals on account of horse thieves.

Mining Resources Slightly Developed

Tegucigalpa has two large hotels and is the center of a rich but comparatively undeveloped mining district. The town owed its foundation to the discovery of mines near-by and indeed first bore the name of "Minas de Tegucigalpa," by which it was known until the latter half of the Eighteenth Century. At present there is only one large producer, the New York and Honduras Rosario Co., with properties at San Juancito, where a modern mill and cyanide plant produce silver and gold bullion at the rate of $100,000 a month. At Valle de los Angeles are situated the Socorro mine with mill and cyanide plant (until lately a small but rich producer), and the Animas mine, said to contain a large body of low grade ore. Other mines near the capital are the Aurora with small mill and cyanide plant, and the Quemazones with a small concentrating plant. In the Sabana Grande district is an important development, and it is known that the *antiguas* of this district were rich and extensive. Another district is Danlé, some distance from the capital, having many promising veins, but at present little work is being done there. Prospecting is being carried on by an American company in the Chile mountains with encouraging results.

Placer Gold and Native Copper

Most of the rivers of Honduras contain gold in greater or less quantity, and the Guayapo River is especially mentioned as having yielded large amounts of the precious metal in ancient times. Prospecting in the mountains is not attended with any difficulty, but on the coast the reverse is true, as the dense vegetation renders observation and progress extremely slow and difficult and the insects render life almost unbearable. There is good reason for believing that there are old mines of native copper somewhere on the Atlantic coast; but, so far as I know, all are idle. The lack of means of communication is a great handicap to the development of the mineral resources of Honduras, but the fact that the country is rich in minerals cannot be questioned. Among the metals known to occur are silver, gold, copper, lead, zinc, mercury and tin.

The mining laws of Honduras are liberal. All mining machinery and supplies for mines are admitted free of duty. The annual tax on a mineral zone is only 25

centavos per hectare (2.461 acres), and on mines, three pesos per hectare. The export tax on gold and silver bars is 5% ad valorem and on precipitates, 10 pesos per ton. In addition to the tax, the law in force since July 1, 1916, provides that mines must be worked to be held, and any mine becomes forfeit if left unworked for a period of one year or if it remains idle for a total of 400 days in any two years even if no continuous suspension should amount to one year. To fulfill the terms of the law, at least four men must be employed and they must

PALM HOTEL, PUERTO CORTEZ, HONDURAS

be employed in actual development work of the mine, inside or out. However, if a mine has been worked continuously for two years, it can be held without working for a further period of two years by payment of a tax of 10 pesos monthly. Furthermore, the forfeiture clause does not apply if suspension of work is the result of war, famine, pest or absolute lack of workmen in the district where the mine is located. The limit for a mining zone is 200 hectares. It has been estimated that about 68,000 hectares have been held without working by the payment of the small tax, and it is the intention of the new law that this holding of mining land for speculative purposes shall cease. As many of the *antiguas* and rich but unworked mines were held in this way, the new law should operate in favor of the prospector and small investor by throwing many properties open for denouncement.

Binary Alloys of Aluminum

In a recent paper by H. Schirmeister in *Stahl und Eisen,* Vol. 35, pp. 648, 873 and 996 (abstr. *Journ.* Soc. Chem. Ind., May 31, 1916), the author studies the influence of the 20 most important technical metals on aluminum, particularly with regard to the rolling properties, tensile strength, elongation and hardness of the resulting alloys. The alloys with a density below 3 are especially considered, owing to their use in airship building.

Zinc-Aluminum—The greatest technical improvement of aluminum is produced by the addition of zinc, and among low-density alloys those containing Zn 12 to 14% are the most important technically. These alloys give nearly the same elongation as pure aluminum, with a tensile strength of 20 kg. per sq. mm. Alloys with Zn 25 to 30% are much stronger, but have a lower elongation and are too heavy. Zinc alloys do not appear to be suitable for making castings. Magnesium-aluminum alloys with Mg less than 3 and over 10% resist atmospheric attack relatively well; with Mg 6% the resistance is least; with Mg above 6 to 7% rolling is impossible; shrinkage is least pronounced with between 3 and 4% Mg; for castings the magnesium should be between 8 and 12%, the alloys richer in magnesium becoming too brittle.

Copper-aluminum alloys resist atmospheric corrosion well, this being the most important practical advantage of adding copper to aluminum; they can be rolled hot with up to 12% Cu, the most advantageous percentage of copper for rolling purposes being between 3 and 4; for castings, richer alloys with 10 to 15% Cu are preferable. Nickel-aluminum—Manufacturing considerations impose a limit of 16 to 18% Ni; alloys with up to 11 to 12% Ni roll easily when hot, those with about 4% Ni being generally employed; alloys with Ni 10 to 12% are used for castings. Cobalt-aluminum alloys offer no advantages over the nickel alloys. Rolling is not possible with over 12% Co. Iron-aluminum alloys have no technical importance, but an addition of 2 to 3% Fe has no harmful effects; it is even advantageous to add up to 4% Fe to aluminum for castings. Antimony-aluminum—The addition of antimony to aluminum does not confer any increased strength, and alloys with more than 6% Sb offer little resistance to atmospheric corrosion.

Silicon-aluminum—The addition of silicon is favorable as the specific gravity of the alloys is nearly the same as that of pure aluminum. The best proportions are 5 to 7% Si for rolled objects and 10 to 12% Si for castings. Alloys with under 8% Si suffer less corrosion in water than pure aluminum; annealing renders the alloys more susceptible to corrosion. Cadmium-aluminum alloys have no technical interest. Tin-aluminum alloys resist atmospheric corrosion relatively well. They can be cold-rolled easily, but crack when rolled hot. The elastic properties are, however, prejudicially affected by the addition of tin. Lead-aluminum—It is not possible to alloy more than 4% Pb with aluminum, and while such additions have no bad effects, they do not confer any technical advantages. Bismuth-aluminum alloys have no technical value.

Chromium-aluminum—Among the rarer metals, chromium is the only one that has a well-marked favorable influence. The maximum amount of chromium attainable in alloys in practice is 5 to 6%. Rolling can

be carried out at 500° C. with up to 4 to 5% Cr, but for rolling purposes not more than 1% Cr is added, and up to 3% for castings. Manganese-aluminum—Up to 5% Mn can be added, and the alloys roll easily. The addition of manganese confers little practical advantage as regards the elastic properties. It can be added, nevertheless, to the extent of 1 to 2% for rolled objects and 3 to 5% for castings. Tungsten-aluminum—Tungsten is more soluble in aluminum than are chromium and manganese, but it affects the properties of aluminum very little. (The tungsten used in the investigation was, however, impure, especially as regards phosphorus.) Molybdenum-aluminum alloys have no particular technical importance, the most useful containing 0.5 to 1% Mo. Vanadium-aluminum alloys roll easily at 500° C. The addition of 1 to 2% V has a certain utility, and castings may contain 3 to 4% V. Titanium-aluminum alloys are easily prepared with up to 5% Ti, and are easy to roll, but appear to have no special technical advantages. The elastic properties are improved somewhat by the titanium. Zirconium-aluminum alloys are very similar to the titanium-aluminum alloys. Tantalum-aluminum alloys have no technical utility.

Unsafe Communication Between Mine Levels

By Arthur L. H. Street*

A machine man employed on one level in defendant's mine was required, in the performance of his duties, to carry a drill to another level for repairs, and while walking along lagging on which there was no guard or rail, he slipped and fell 20 ft., sustaining severe injuries. He brought suit for damages on the ground that the defendant had negligently failed to provide him with a reasonably safe means of passing through the mine, a ladder in a manway not being available for his use on account of a break which had occurred two or three days previously. The trial resulted in a judgment in his favor, which has been affirmed by the United States Circuit Court of Appeals, Ninth Circuit (Johnson vs. Gold Hunter Mining and Smelting Co., 234 Federal Reporter, 849).

The higher court holds that defendant was bound to use reasonable care to keep the ladder in safe condition; that plaintiff was under no obligation to repair the ladder himself; and that, since the means he took of passing from one level to another was the only practical way open to him, he did not assume the risk of being injured through its defective condition, especially since the defects had been drawn to the attention of the plaintiff's superior, who had assured him that they would be remedied.

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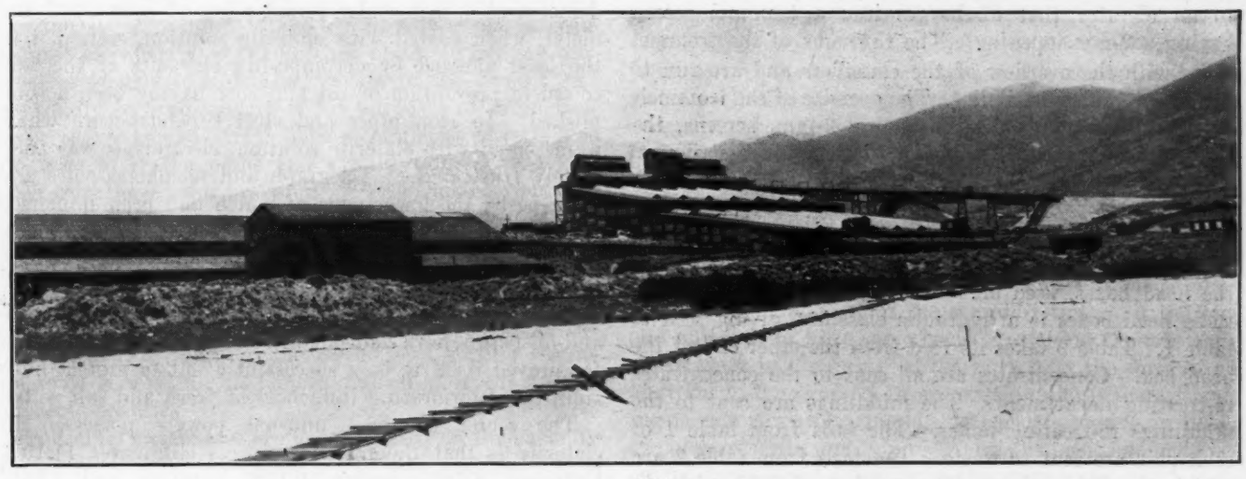
Ohio Copper Concentrator

By George O. Deshler*

The Ohio Copper concentrator, situated at Lark, Salt Lake County, Utah, and now being worked under lease by the General Exploration Co. of Salt Lake City, is treating an average of 2,400 tons of ore per day. The concentrator consists of two parts—the mill proper, in which the crushing, grinding and sand concentrating is done, and the slimes plant, situated about 600 ft. east of the mill and treating slimes only. The mill, as well as the slimes plant, is composed of three units, although the coarse-crushing plant, having a capacity great enough for all three units, is centralized in unit No. 2.



CONCENTRATOR AND SLIMES PLANT, OHIO COPPER PROPERTY, AT LARK, UTAH

Description of the Flow

The ore is dumped from the mine cars into bins over units Nos. 1 and 3. From the bins it is fed by revolving drum feeders, each driven by an eccentric through a ratchet and pawl, giving an intermittent movement to a steel pan conveyor. These conveyors meet over unit No. 2 and drop the rock on a grizzly. The oversize drops into a 24x16-in. Blake crusher. The throughs from the crusher unite with the throughs from the grizzly and drop into a set of 60x24-in. Garfield rolls. This roll product goes to a 36-in. elevator, 91 ft. high, discharging on 12 stationary screens set at an angle of 45°. The oversize from these stationary screens drops to two sets of Garfield rolls. The roll product returns to the 36-in. elevator and is returned to the stationary screens forming a closed circuit. The throughs from the screens drop on a 24-in. belt conveyor, 57 ft. long, and are dropped into the fine-ore bins. The final product from the

*Assistant superintendent, Lark, Utah.

coarse-crushing plant is approximately 3/8 in. in diameter and under.

A description of one of the three units in the fine-crushing and concentrating plants will answer all purposes, as the units are identical, except that in No. 2 a Hardinge mill is being used in place of chilean mills.

From the fine-ore bins the pulp is fed by challenge feeders into two 20-in. elevators, discharging on four sets (of two each) of Colorado impact screens. The oversize drops to four 42x16-in. rolls. The product of these rolls goes to the elevators and is returned to the screens. The screens here are of 8- and 10-mesh. Water is added to the throughs, and they are run to two-spigot hydraulic classifiers. The spigot discharge is run to roughing tables. The tails from the tables treating the second-spigot product are run to waste. The concentrates from all tables are sent to the finishing tables. The tails from the tables treating the first-spigot product are run to an elevator that discharges into a trommel screen having a 2-mm. opening. The throughs of the trommel unite with the overflow of the classifiers and are run to a Kennedy pulp distributor. The oversize of the trommels drops to four chilean mills having 2-mm. screens, the discharge of which is also run to the pulp distributor. The pulp is distributed to six rows (of nine each) Wilfley tables. The tables are arranged in pairs, and at the head of each pair is a head box receiving the pulp.

On unit No. 3 four-spigot classifiers take the place of the head boxes, used on units 1 and 2. At one end of these head boxes is a hydraulic classifier, giving feed to table 1. Table 2 takes its feed from the other end of the head box. Concentrates are all sent to the concentrates re-treating department. The middlings are sent to the middlings re-treating tables. The tails from table 1 of each pair are sent to waste. The tails from table 2 are sent to the slimes plant. The overflow of the head boxes also goes to the slimes plant.

In the concentrates re-treating department all concentrates are received in hydraulic classifiers having three spigots and an overflow. The spigot-discharges are fed to Wilfley tables and the overflow is settled in tanks, the thickened product going to tables and the overflow to concentrate bins. Concentrates from these tables are sent to concentrate bins, the tailings to waste and the middlings to a three-spigot classifier, the product of which is treated on Wilfleys. The concentrates from the re-treating plant are sent to an elevator discharging into a trommel, the oversize from which is jigged to recover coarse mineral. The tails are sent to the chilean mills and the concentrates to the concentrate-bins.

Slimes Plant and Water Recovery

In the slimes plant the pulp is thickened in Callow tanks, the underflow going to Deister slime tables and the overflow to a centrifugal pump which returns the water to the mill proper. The Deister tables makes a slimes product, the concentrates going to a concentrate bin, the tails to waste and the middlings to elevator and returning to tables.

The general tails are all sent to the tailings pond and settled, the clean water being returned by 12x12-in. Aldrich triplex pumps to the mill proper and used again. Extensive flotation experiments, with every indication of success, are being conducted on both the sands and slimes.

Recent Uses of Utah Elaterite

By Elihu Palmer*

Elaterite, or "mineral rubber," occurs in vast beds in eastern Utah, associated with other hydrocarbons. Recent tests show it to be a useful agent in the world of industry, when brought into commercial form, in solution, and used as a coating or paint. When spread over surfaces of wood, iron, steel, tin, leather, rubber, cork, concrete or other substances the solvents evaporate, leaving an intensely close-grained luminous ebony-black veneer which is practically poreless. This coating is more than 99% pure carbon and is said to be proof against acid, alkali, water, electricity, oxygen and nitrogen. It is serving with conspicuous efficiency as a coating for tanks and other containers designed for holding solutions used in galvanizing and recovery of gold and silver from low-grade ores.

Experiments extending over the last four years have demonstrated that underground pipes of both wood and metal, when coated with elaterite solution, were not in the least affected by decomposing elements of the soil, complete prevention of rot and rust having been accomplished. In iron pipes and steel superstructure which were coated with elaterite solution, electrolysis was completely frustrated. Telegraph and telephone poles and fence-posts, the lower ends of which had been immersed in elaterite solution before burial in the ground, were found to have remained sound and their elaterite covering was entirely unaffected by the soil.

In its utility as a coating for marine craft, where lead-and-oil-paints have had but brief lives, elaterite has thus far proved itself to be a successful agent to protect hulls from the deteriorating influences of fresh and salt water.

The secret of these unusual powers possessed by elaterite is that the refining process eliminates 11.19% hydrogen, 4.78% oxygen, 0.17% nitrogen and 0.24% sulphur which the characteristic crude product contains, after which contraction of the substance becomes so acute as to prevent the passage of water or air through the coating.

The permeating of the elaterite solution into the minute pores of substances to which it is applied constitutes a series of thread-like supports of the coating; hence it does not crack or peel. The qualities of the crude product, suggesting the name of "mineral rubber," are largely retained; and therefore as a coating solution it adjusts itself readily to gutta percha products, preserving these effectively from degeneration by nitrogen and oxygen. Elaterite solution also performs similar service on leather, making a coating thereon which does not crack or peel, and imparting to such articles as automobile upholstery a permanent black gloss, waterproof and almost indestructible.

Philippine Iron Ores are found chiefly in Luzon and Mindanao according to a recent paper by Wallace E. Pratt, of the Bureau of Science at Manila. It is now recognized that the iron-ore deposits in the eastern Cordilla of Luzon constitute, not a continuous belt, but a series of widely separated deposits, including a half dozen ore bodies within a distance of 10 miles in Bulacan Province, a single outcrop at Santa Inez, Rizal Province, farther south, and three deposits around the margin of the Mambulao-Paracale gold mining district in Camarines Province, 100 miles farther to the east-southeast. Other unimportant occurrences of magnetite-hematite ores are known, but the foregoing, together with the lateritic ores in Surigao Province, Mindanao, contain the economically important iron ore reserves of the Philippines.

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Estimating Construction Costs

By Frederick W. Foote*

SYNOPSIS—A general consideration of the present status of estimating with examples from practice based on the ratio of labor and material that enter into the work. When possible, figures are given that show the general trend of the work of construction and indicate the relative importance of labor and material for the different parts of modern plant construction.

For the sake of convenience the subject of estimates will be divided into two classes. The first class will be the estimates of a preliminary character which are arrived at by hasty methods of comparison with previous construction of similar nature. These are usually given in costs per unit of capacity of the finished plant. They are prepared previously to a detailed review of the project and are usually incorporated in it for purposes of estimating the necessary amortization. The second class of estimates are made after the plans and specifications of the proposed work have been prepared. These construction estimates are given more in detail and are based on the bills of material and plans. They are used to determine the required appropriations and, to a certain degree, the subsequent accomplishment of the construction engineers.

It is the purpose in this paper to give some idea of the limitations of estimating, the methods of getting results and some general useful factors arrived at in practice in different localities.

Preliminary estimates are usually based on the capacity of the plant when completed. If the undertaking is purely one of mining, the estimate must include the cost of the following divisions: The headworks and ore bins, the power plant, the offices and dwellings and the industrial system. If milling is to be undertaken, to these must be added the crushing plant, milling plant and tailings disposal or retaining plant. In the case of smelteries, the pretreatment plant (roaster, crusher, etc.), the smelting plant proper, the stack and other minor parts must be considered. Properly under the province of the mining engineer, preliminary estimates must be given on refineries, acid plants, industrial towns, dredges and numerous other projects.

Some Examples of Unit Plant Costs

The following mine-plant unit costs give an idea of the range of costs to be expected: Nipissing, $1 per ton of annual capacity; Arizona power plant, $1.12 per ton; Arizona surface plant, $0.87 per ton. Roughly, $1 a ton should cover the mine plant proper and $1 a ton for the power-plant requirements. To the mine-plant costs must be added the following, if milling is contemplated: Joplin concentrating mill (50,000 tons cheapest) 12@16c. per ton annual capacity; gold mills, $1.25 per ton; cyanide mills, $1.50 per ton; flotation plants, $1.25 per ton; miscellaneous, $3 per ton. The average of several assorted types of mills in Liddell's handbook is $1.50 per ton.

The costs of several different milling plants are given in Table 1, taken from articles recently published.

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For smelting works $5 a ton is a good round figure, as an average of six smelteries of copper, lead and zinc was $5.13. Acid plants in connection with smelteries cost about $7 per ton of acid produced annually. About

TABLE 1. COSTS OF MILLING PLANTS

Mill	Type	Daily Capacity, Tons	Total Cost	Cost per Ton of Annual Capacity
Uwarra, Candor, N. C...	Cyanide	50	$42,796	$2.85
Tough Oakes, Ontario..	Cyanide	100	121,820	4.07
Nipissing, Ontario	Cyanide	240	254,839	3.54
Belmont, Nevada	Stamp	500	465,189	3.54
Boston Con., Utah.....	Conc.	3,300	.....	1.50
Garfield, Utah	Conc.	7,300	.....	1.85

10% of the plant cost should be allowed for the townsite construction work, 7% for the industrial system and 5% for the engineering expense.

The foregoing figures together with the experience and judgment of the engineer should enable the estimator to give a preliminary estimate quickly and within reasonable accuracy. In other words, an idea of the cost of the proposed plant can be gained without going into detail.

Final Construction Estimates

The final construction estimates are prepared from the finished plans and specifications of the plant to be built. The first object of these estimates is to provide a basis for the apportionment of the appropriation, and the second object is to have some basis for gaging the efficiency of the work in the field. If the work is in the form of an addition to the capacity of an existing plant, the estimating is comparatively simple. It consists merely in using the old cost data and applying any changes that have occurred in material prices or in the wage scale.

In the case of new work, however, more care and judgment must be shown. If possible, there should be a separate estimating department to which the plans are given by the engineering department. The current wage scale in the locality where construction is to be undertaken is obtained for all classes of labor used. This includes the types of labor given in Table 2.

TABLE 2. CLASSES OF LABOR IN CONSTRUCTION WORK

Blacksmiths	Laborers
Blacksmiths' helpers	Lead burners
Boilermaker boss	Machine-shop boss (outside)
Boilermakers	Machinist
Boilermakers' layer-out	Machinist helpers
Boilermakers' helpers	Miners, underground
Brick masons	Miners, surface
Brick tenders	Pipe fitter boss
Carpenter boss	Pipe fitter
Carpenter	Pipe fitter helpers
Carpenter helpers	Plasterers
Cart drivers	Plumbers
Cement finisher boss	Plumbers' helpers
Concrete boss	Rigger boss
Concrete mixers	Rigger
Corral boss	Rigger helpers
Corral men	Stone mason boss
Drillers	Steam fitters
Electrician boss	Steam fitters' helpers
Electrician	Tinners
Electrician helpers	Tinners' helpers
Engineers, locomotive	Toolroom man
Engineers, compressors	Tool sharpeners
Engineers, stationary	Track boss
Janitors	Water boys
Labor bosses	Warehouse help

It is well to find out if the types required are available in the locality and if not, an additional charge must be added for their importation.

The material question is next considered. Table 3 contains the main basic materials from which plants are constructed.

Any other material required for specific parts should be added. The prices of this material, in different bulks, should be ascertained at the nearest available point in quantities sufficient for the requirements of the project. The prices of iron and steel, metals, piping and shop supplies at different centers can be found in the weekly issues of the *American Machinist*. In addition to these *Engineering News*, in the first issue of each month, publishes a list which contains the prices of cement, sand, brick, lumber, pipe, etc., at the principal centers. In the absence of quotations from dealers these figures are convenient to be used. Freight rates to the site should be investigated and added to the cost of material. These may be obtained by writing to the railroad over whose lines transportation is contemplated.

Ratio of Labor and Material in Construction

The estimator now has the cost of material and labor at the plant site. The next step in the procedure consists in calculating the several bills of material from the plans. I have found, from experience on several projects, that it is advisable, after these bills of material are calculated, to segregate them into the basic component materials and add these together. The following several paragraphs are devoted to a partial list from my note books, which will give an idea of the material considered. The sum of

TABLE 3. BASIC MATERIALS OF CONSTRUCTION

Asbestos sheets	Lead, white
Brick, red standard	Lime, burnt
Brick, magnesite straights	Nails, common, base
Brick, special shapes	Oil, linseed
Bolts, carriage	Paint
Bolts, machine	Pipe, black, 1-8-in.
Belting, conveyor rubber	Pipe, sewer, 6-, 12- and 24-in.
Castings, rough iron	Rails
Cement	Rope, manila, base
Clay, fire	Sand and gravel
Conduit, galvanized	Shafting
Glass	Steel, structural
Iron, corrugated	Ties
Iron, galvanized	Tile
Iron, round and square, base	Valves, gate
Iron, flat, base	Wire, weatherproof
Iron sheets	Wire, heavy double-braid stranded
Lumber, common	Wire, galvanized
Lumber, T. & G. flooring	

these several material lists and the necessary fractional additions for waste, extras, etc., will give a convenient figure for the purchasing department to use in its endeavor to get favorable bids for the requirements. It is a well-known fact that more favorable prices are obtained when purchasing is done in bulk initially instead of in small quantities from time to time.

A knowledge of the ratio of material cost to labor cost is most desirable in the making of estimates, as it is the means of connecting the bill of materials (which can be

TABLE 4. RATIO OF LABOR AND MATERIAL

	% Material	% Labor
Asphalt work	48	52
Brickwork	45	55
Brickwork, special shapes	80	20
Belting, conveyor	88	12
Belting, transmission	82	18
Concrete	54	46
Electrical inside wiring	49	51
Electrical outside wiring	65	35
Electrical equipment	88	12
Timberwork	67–50	33–50
Millwork	67–50	33–50
Pipefitting	67	33
Pipelaying	50	50
Painting	44	56
Rails, laying	80	20
Steelwork	82–63	18–37
Tanks, steel	68	32
Tanks, wooden	50	50
Machinery	95–65	5–35

computed within small limits) with the final cost of the several projects. It has been my experience that the ratio of labor and material for the different types of work varies within well-defined limits. If material prices increase, a wage increase usually follows within a short time. Similarly, for instance, the ratio of labor and material is pretty nearly a fixed value irrespective of locality. Table 4 is based on construction experience in Arizona, Ontario and Virginia, together with estimates for work in other localities, so that I feel that it is fairly representative of American conditions. Data on foreign construction are lacking at the present time.

Brickwork, Belting and Concrete Estimations

Having applied these ratios to the several bills of material, their sums represent the estimated cost of the plant. However, this is not complete. Provision for housing the men during construction must be added, as well as superintendence and engineering, cost of field offices and force and all general charges. These can be found within reasonable accuracy. The final sum of these several quantities should be used as a check and the construction work held to within 20% of the estimate. Enough of each type of work will now be taken up with what data are pertinent to give an idea of the subject. Brickwork will first be considered. Table 5 gives some figures from which dedeductions can be made.

TABLE 5. RATIO OF MATERIAL AND LABOR IN BRICKWORK

	% Material	% Labor
Virginia, average	47.5	52.5
Arizona, average	47	53
Miscellaneous, average	43.7	56.3
General, average	46.1	53.9
Arizona, special shapes	79.2	20.8

The table of brickwork ratios shows that the sum of the cost of the brick, cement and sand is about 45% of the total, while the cost of laying is 55%. For ordinary estimations 19 bricks, 9x4½x2½ in. should be allowed per cubic foot. This includes the space filled by the cement. Table 6 is useful in estimating cement and sand requirements.

TABLE 6. SAND AND CEMENT FOR BRICKWORK
(Exact quantities. Waste must be added)

Kind	Size	Cu.In. Each	No. per Cu.Ft.	Mortar, Cu.Ft. per M Bricks	Cement, Cu.Yd. per M Bricks	Cement, Bbl. per M Bricks	Sand, Cu.Yd. per M Bricks
Acid	8¼x3¼x2¼	69.5	22	0.50	0.125	0.89	0.375
	8¼x4 x2¼	74.2	21	0.53	0.133	0.94	0.399
H. B. shale	8¼x4 x2¼	74.2	17½	0.68	0.17	1.21	0.51
	8¼x4 x2	66.0	20	0.60	0.15	1.07	0.45
Red	8 x4 x2	64.0	19	0.68	0.17	1.21	0.51
	8¼x4 x2¼	74.2	16½	0.80	0.20	1.42	0.60
Fire	9 x4½x2½	101.0	17				
	9 x4½x2	81.0	21				

Choice should be applied to the factors according to the following rules of brickwork: Large, even runs, as in walls, chimneys, etc., are laid more quickly so that low labor percentages should be used. Small foundation piers, manholes, etc., are made with more delays so that higher labor percentages are used. Special shapes for furnaces, etc., are expensive so that the material percentage should be high. They are not any harder to lay, but are worth more. In asphalt painting, the material runs 48% and the labor 52%.

The following data give an idea of the ratio of labor and material in the installation of belts for conveying and driving machinery. An average of five conveyor-belt installations gave 88% for material and 12% for labor. In the case of drive belts with the necessary pulleys and shafting, material is 82% and labor 18%.

There is such a mass of data available on concrete costs that no attempt will be made at citations. An average seems to be material 54%, labor 46%. A good figure for total cost per cubic yard is $10.

Electrical work falls naturally into three classes—wiring, inside and out, and electrical-equipment installation. Table 7 gives average figures applicable to estimating work.

TABLE 7. RATIO OF LABOR AND MATERIAL IN ELECTRICAL WORK

Type of Work	Location	% Materials	% Labor
Inside wiring	Arizona	48.5	51.5
Inside wiring	Virginia	49.2	50.8
Inside wiring	Average	49.0	51.0
Outside wiring	Virginia	65.0	35.0
Outside wiring	Ontario	62.0	38.0
Outside wiring	Arizona	69.6	30.4
Outside wiring	Massachusetts	63.5	36.5
Outside wiring	Average	65.0	35.0
Equipment installation	Arizona	86.8	13.2
Equipment installation	Ontario	88.2	11.8
Equipment installation	Average	88.5	12.0

The work performed by carpenters can be divided into timberwork and millwork. Timberwork consists of the necessary framing, siding, roofing, flooring, etc., while the millwork consists in setting the window frames, door frames, hanging doors, etc. In estimating this work, the ratio will have to be worked out for the given locality. In Arizona lumber costs $26 per M ft. b.m., while in British Columbia it costs $9 per M. Carpenters receive $4.50 per day in Arizona against $3.75 in British Columbia. The data at hand show that in regions where timber is high (around $25 per M) labor is 33% and material 67%, while in the Northwest and in other localities where timber is plentiful they run about 50% each. In timber estimates about 5% should be allowed for waste in cutting, matching, etc. In Virginia a rough figure for labor of $6 to $7 per M for siding, $8 to $10 for framing and $10 total per opening for doors and windows was usually justified. This is about the 33% labor basis. There is less difference in millwork. Virginia averages were 35% for labor, Arizona 31% and Ontario 50%. In connection with timberwork 20 lb. of nails per M ft. b.m., is a good figure to use.

Pipework, Painting, Steelwork and Tanks

Pipefitting will be used to apply to all iron pipes used in construction work having flange or threaded joints to distinguish from iron water pipes, which have bell-and-spigot calked joints. Pipefitting runs about 33% each for labor, pipe and fittings.

Pipelaying consists in the work of laying and calking bell-and-spigot pipe. This may be either iron or terra cotta. In laying iron water pipe about 50% is chargeable for labor and 50% for material, while in the case of terra cotta pipelines, 33% is spent for labor and 67% for material.

Painting results are quite uniform, being about 56% for labor and 44% for material for a good average for estimating purposes. One gallon covers 125 sq.ft. in two-coat work on smooth runs.

For the plant industrial railroad system, excluding the necessary excavation, which is variable, 20% should be allowed for labor and 80% for material.

Steelwork is usually let out on contract for supplying material and erecting and for this reason data on the subject are scarce. In Arizona steelwork was erected by contract of which the labor cost is estimated at 37% of the total. A Michigan headframe[1] cost 18.8% for labor. A Bisbee headframe[2] cost $1,400, of which 20.7% was for labor in erection. A general value of 25% for labor should meet requirements where specific data are lacking.

Tanks can be divided into steel and wooden. A contract for steel tanks in Ontario was based on 32% for labor and 68% for material. In erecting wooden tanks about 50% each should be allowed for labor and material. Cypress costs more for material than pine. In a specific instance a cypress tank ran 48% for labor and a pine tank ran 55% for labor.

The bill of materials for machinery should contain the list of the weights of the several parts. The labor cost per ton of weight is a useful factor for estimating total cost. The heavier the parts the lower the labor cost and the lower the labor percentage. Table 8 will give an idea of the range to be expected.

TABLE 8. LABOR AND MATERIAL RATIO IN MACHINERY ERECTION

Location	Type	% Material	% Labor	Total Cost per Cwt.
Ontario	Boilers	63.1	36.8	....
Ontario	Crusher machinery	76.4	23.6	....
Ontario	Cyanide machinery	82.8	17.2	....
Arizona	1—Engine machinery	95.5	4.5	$13.59
Arizona	2—Heavy	90.3	9.7	10.03
Arizona	3—Massive	95.5	4.5	12.72

Excavation has not been considered, as the preliminary plans do not show how much is necessary. It should be figured in cubic yards, for which it should be divided into rock and earthwork. A good round figure for earthwork is $0.50 a cu.yd. and for rockwork a figure of $1.50 is convenient. So many variables enter into this calculation, it is advisable to work out each detail with care.

The foregoing percentages are not given so much for actual use as to show the method of estimating and to give an idea of the relative value of the factors entering into the consideration. If engineers keep their cost data in this form they will find that at the end of a few years they have figures that are surprisingly uniform and the use of which gives very fair estimates. Table 9 gives a random list of some percentages that practice has proved to be applicable for estimates.

TABLE 9. SOME MISCELLANEOUS RATIOS

Type of Work	% Material	% Labor
Small wooden building, field offices, bunks, etc.	75	25
Water system, including excavation	62	38
100,000-gal. reservoir	40	60
Pumphouse	32	68
Average of several large wooden buildings	53	47
Sewer system	35	65
Concrete roads	60	40
Crusher station	70	30
Cyanide plant	73	27
Mine plant shop	63	37
Boiler house	59	41
Heating system	88	22

It might not be amiss to give a few ideas on the carrying out of construction work based on estimates. It is due the subject of estimating to give some reasons why estimates often fail and to show the causes. The cost of a project in Arizona, we will say, is estimated by the home office in Boston. The estimators are provided with a list of current material prices and the current wage scale, they calculate the probable cost of the finished project, and an appropriation is authorized to cover this. At the completion of construction this appropriation was found to have been exceeded by 20%. Of course there were two possible explanations. The estimate was too low or the construction costs too high. An investigation of the question showed that additional work and changes had been made. The work had been delayed until bad weather, which materially increased the costs, without any blame to the engineer. A recalculation showed that the cost of the work as originally called for was 10% under the estimate. The changes, additions and extra cost due to

[1] "The Steel Headframe at No. 9 Shaft, Republic Mine, Vulcan, Mich.," by Floyd L. Burr, "Eng. and Min. Journ.," Vol. 100, p. 434.

[2] "A Bisbee Headframe," by P. E. Barbour, "Eng. and Min. Journ.," Vol. 99, p. 330.

weather conditions brought the final expenditure up to 15% over the estimate. Of course, here it is obvious that 25% for changes, additions and extras argues faulty original design.

Using Estimates to Check Construction

In the actual construction work it is advisable to keep the estimated cost expressed in percentage in view and arrange to have occasional checks during the progress of the work. See how much it costs to lay $10 worth of brick or to frame $10 worth of timber and see if the resulting percentage agrees with the estimate within reasonable limits. If it is consistently different, send in new figures for a revised estimate and take steps to get an additional appropriation. If the results are intermittently irregular, it suggests that the work is not proceeding in the most expeditious manner.

Time-Factor Value of Estimates

To show the value of estimates, I will cite a case that occurred recently. An additional unit in an already operating plant was required by a certain date. Cost data in the hands of the construction engineers enabled them to calculate the number of hours of each type of labor required for the completion of the additional unit. It was thus easy to calculate the necessary working force. A percentage progress diagram, plotted weekly, showed at a glance whether the work was proceeding slower or faster than necessary and hence whether men should be hired or fired. The unit was completed upon the day set originally. This illustrates the time-factor value of percentage estimating. With these few hints, I feel that some may realize more the value of estimates, both initially and as aids during construction.

Frequent reference has been made to various published data from which figures were obtained for the purposes of amplification of my notes. I wish to express my thanks for data obtained from "Unit Construction Costs," by E. Horton Jones, Trans. A.I.M.E., Vol. XLIX; "Building the Tough Oakes Mill," by John A. Baker, *Engineering and Mining Journal,* Vol. 100, pp. 869-874, 915-918; "Cost of Mill Construction," by H. T. Curran, *Engineering and Mining Journal,* Vol. 100, pp. 345-347; and from other scattered sources.

Repairing a Spoiled Tracing

It sometimes transpires that, after several hours or even days have been spent in preparing an elaborate tracing—usually in the cases where circumstances require that the finished drawing be worked up on the tracing cloth itself—by some unpreventable accident, or by eccentricity of motion on the part of tired fingers, a catastrophe occurs which cannot be remedied by ordinary erasure. It may be a large blot or a jagged line where no line should appear. Again, the title of the drawing may have to be changed, for reasons best known to the boss.

The highest ideals demand that an entirely new tracing be prepared. But perhaps the press of other duties will not permit this, or else a shortage of material in a remote camp makes it impracticable. Select an area to censor, usually of rectangular shape. With an old safety-razor blade cut out the objectionable part. Then, from a scrap of similar material cut out a piece of concentric shape and large enough to overlap at least 2 mm. each way. Place it over the eliminated area, in proper alignment, and put a weight on it to hold it there. Next take a tiny dab of glue or china cement on a chisel-shaped piece of wood, such as a sharpened toothpick, and glue a short section of the patch. Be careful not to get any glue beyond the edge of the patch, and press each section down firmly so that it dries without a wrinkle. Proceed, section by section, until the entire joint is completed. When all is dry, ink a line on the patch to conceal the cut edge of the tracing. When this is dry, the whole tracing is turned over and a line is inked to conceal the edge of the patch. The job being finished, proceed with the new title, bill of materials or whatever may be required. The neat double line conceals all evidence of patching in the final print and furnishes a neat border. Before adapting this method to unauthorized collaborations, it is well to study the local statutes concerning constructive forgery.

American Mining Congress

The nineteenth annual convention of the American Mining Congress opens at the Hotel La Salle, Chicago, Nov. 13, 1916, and the general as well as the section meetings will be of unusual interest and value to mining men in all branches of the industry. All meetings of the congress are open to the public, and mining men especially are invited to attend and to assist in the discussions.

The general sessions will be held during the morning hours. Each afternoon there will be three great section meetings, covering the metalliferous field, oil and gas and coal.

The opening topic on Tuesday, Nov. 14, will be "The Record of Mine Safety Work," led by Albert H. Fay of the United States Bureau of Mines. This will be followed with addresses on "State Mine-Rescue Methods," by Dr. H. H. Stoek, of the University of Illinois, and "Safety Work as an Investment," by Dr. C. W. Goodale, of Butte, Mont. The important discussion of the day will be on the subject, "The Responsibilities of the Operator, of the Miner and of the Public."

On Wednesday in the general meeting, Van. H. Manning, director of the United States Bureau of Mines, will speak on "Federal Aid to Mining Efficiency" and Chairman E. N. Hurley, of the Federal Trade Commission, will address the convention on "The Federal Trade Commission and the Mining Industry." The report of the committee on "Relations with the Federal Trade Commission," by Chairman Charles M. Moderwell, will be open for discussion.

On Thursday, which will be devoted to the general topic, "Conservation," there will be addresses by Dr. W. R. Whitney, chief of laboratory work of the General Electric Co., who will call for Federal aid in research work, and "The New Things in Science," by Dr. F. G. Cottrell, of the United States Bureau of Mines. The topic for discussion will be "Waste in the Mining Industry—in Mining, in Distribution, in Use." This will be led by the leading experts in the industry.

At the banquet, Thursday evening, Carl Scholz, of Chicago, president of the congress, will speak on "Coöperation the Basis of Safety, Efficiency and Conservation in the Use of the Nation's Mineral Resources."

Col. George Pope, of Hartford, Conn., president of the National Association of Manufacturers, will speak on "Organized Capital and Organized Labor and Their Relation to Efficiency, Conservation, Better Wages, Better Living Conditions, Lawlessness, Strike Disorders and Industrial Freedom."

On Friday the visiting mining men will be taken on an excursion to the Gary steel plant. There will be several evening sessions, all open to the public, at which industrial moving pictures will be shown. Among these will be films showing the Mexican oil fields near Tampico, including a view of the famous Cerro Azul Gusher and others covering mining in the arctic regions of Alaska and Siberia.

Van. H. Manning, director of the United States Bureau of Mines, will attend the sessions of the congress, and with him will come the leading experts of the bureau. Mr. Manning has notified J. F. Callbreath, secretary of the congress, that the Government exhibit at the convention will surpass any display yet made by the bureau. There will be a collection of 175 underground coal-mining safety pictures, arranged in series, and a group covering the same idea in metal mining. In mine-rescue and first-aid display there will be a set of Fleuss-Proto apparatus, the Bureau of Mines oxygen inhalator, the Bureau of Mines first-aid cabinet, the Bureau of Mines surgeon's emergency chest and a floor plan of one of the new steel cars.

The "Public Lands" conference, which is to be held at Chicago in conjunction with the convention, will have as delegates the West's most representative men, including a group of Senators and Representatives, who promise to bear the message of the gathering direct to the halls of Congress. The men who have been chosen as delegates are determined to formulate a Western policy on this question, which will give to every state the power to develop the vast resources which have, in a way, been locked up by Federal regulations and enactment.

The letters received from the governors give a clear idea of the general trend of the conference. For instance, one governor says that "there is even in the West a group of men that proceeds on the assumption that the state is not fit to care for the resources God has given it, and that the only administration of them which can be equitable to public interest must be centralized in Washington."

Flotation Case in Supreme Court

WASHINGTON CORRESPONDENCE

Concentration of ore by the flotation method took place on Nov. 1 in the historic room occupied by the Supreme Court of the United States. The courtroom was crowded with noted counsel and many persons interested in the argument of the case of the Minerals Separation, Ltd., of London, and the Minerals Separation American Syndicate, Ltd., the petitioners, vs. James M. Hyde, of Butte, Mont., and Palo Alto, Calif. This is the hearing on writ of certirori, of the appeal from the decision in favor of Hyde before the United States Court of Appeals at San Francisco.

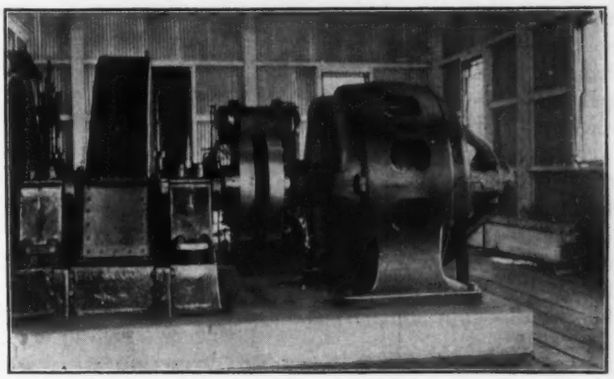
The following noteworthy array of attorneys appeared in the case: Lindley M. Garrison, Henry D. Williams, F. D. McKenney, John H. Miller, O. W. McConnell, William H. Kenyon, Thomas F. Sheridan, George L. Wilkinson, Walter A. Scott, K. R. Babbitt and J. Bruch Kremer.

Electric Drive at Empire Mine

The Empire mine is situated at Grass Valley, California. As greater depths were reached, it became necessary to install a larger hoist and to redesign the mill. Electric operation was decided upon, and the Westinghouse Electric and Manufacturing Co., of East Pittsburgh, Penn., received the contract to install a 500-hp. electric hoist and to equip the mill with motor drive. Noteworthy features of the hoist installation include herringbone gears, liquid rheostat-control and electrical safety devices.

The hoist is of the double-drum type, made by the Wellman-Seaver-Morgan Co., and embodies several features unique in California mining practice. The most important is that the hoist drums are geared by a single-reduction herringbone gear to a comparatively high-speed phase-wound induction motor having a gear ratio of 14 to 100, the motor running at a full-load speed of 435 r.p.m. With two layers of rope on the drum, this gives a hoisting speed of 1,200 ft. per min. in the shaft when all resistance is cut out of the controller.

The hoist drums are 6 ft. diameter and have a capacity of 8,000 ft. of rope per drum. They are to handle 4



WESTINGHOUSE 500-HP., THREE-PHASE, 60-CYCLE, 1,040-VOLT, PHASE-WOUND INDUCTION MOTOR OPERATING HOIST AT EMPIRE MINE, GRASS VALLEY, CALIF.

tons of ore at a rate of 1,200 ft. per min. from a depth of 7,500 ft. The gears have a 14-in. face, are inclosed in a sheet-iron case lagged to deaden the sound, and run so quietly that they cannot be heard from the opposite end of the hoistroom. By employing this type of gear connection the efficiency of the hoist is increased and the poor power factor of a low-speed motor direct-connected to the drum of the hoist is avoided.

ALL BRAKES CONTROLLED BY AIR

The hoist mechanism is controlled from the main operating platform, all brakes being controlled by air. Air for operating the valves is obtained directly from a main compressor line that furnishes air for the mine. There is, however, a small motor-driven compressor installed, which works in parallel with the main line; and in case the pressure falls below a certain limit in the reservoir, this small compressor cuts in and maintains sufficient air pressure to operate the brakes at all times.

The hoist motor is a 500-hp. three-phase 60-cycle 1,040-volt Westinghouse motor, operating at 435 r.p.m. at full load. This motor is connected to the pinion of the hoist through wire-link flexible couplings. The motor

has been designed so that plugging and regenerative braking are possible. This means that when the operator wants to stop the skips by reversing the current in the motor while running, this will not overstrain the windings or cause any electrical trouble. This feature is one of the latest developments in alternating-current hoist motors. The motor is controlled by a liquid rheostat. The resistance in the secondary of the motor is regulated by the height of water on the plates on the upper tank of the rheostat. The height of water on the plates is governed by a weir in the tank. The weir is motor-operated and is controlled from the operator's platform.

The liquid controller is so adjusted that the operator can hoist men or an empty skip from any point in the mine at a speed not to exceed 500 ft. per min. On test this speed was greatly reduced, demonstration being made that the control equipment would allow a reduction of speed so that a skip containing one man could be raised from the bottom of the mine to within 200 ft. of the collar of the shaft slowly enough to allow an inspection of the shaft. The advantages of this type of control include the wide range of speed that can be obtained under low-load conditions, the economy of space as compared with the grid type of resistance, the low cost of upkeep, the insurance against fire due to short circuits in the secondary resistance, and the ease with which it handles the load, there being no jerks or sudden strains put upon the equipment between the time of starting and full-load speed of the motor.

Although at the present time the mine is at a depth of only 6,000 ft. the hoisting equipment has been installed to handle to a depth of 7,500 ft. The equipment, working at a depth of 7,500 ft., will handle an equivalent of 30 tons an hour. The present output per shift is 150 tons. The shifts consist of three 8-hr. periods, and the hoist works approximately six hours in each shift.

Safety Device Prevents Overwinding

In connection with the hoisting equipment several safety devices have been utilized, one of which is a geared limit-switch. This switch is operated by bevel-gear drive from the shaft and operates the indicator. It is set so that the engineer must have his hoist under control when the skip reaches a point 200 ft. from the collar of the shaft. If he does not, the switch trips the circuit-breaker on the motor equipment and automatically sets the air brakes, bringing the skip to rest by the time it reaches the collar of the shaft. An additional equipment has been installed to prevent the operator from allowing his skip to come into the dump at too high a speed, thereby tending to rack the headframe. This equipment is similar in operation to the one already described.

The ore is moved from the ore chute to the mill by a 3½-ton Westinghouse mining locomotive, which handles six 3½-ton cars. A 60-stamp mill is installed, divided into six batteries of 10 stamps each. Each battery is driven by a special back-geared, 35-hp. three-phase 60-cycle 440-volt 850-r.p.m. Westinghouse motor belted to the bullwheel, which is mounted on the camshaft operating the stamps. The gears have a reduction of 5¾ to 1. The stamps are considerably heavier than those ordinarily used, being 1,360-lb. each. Each stamp handles five tons of ore per day. The motors are set back from the mill as much as possible, on separate concrete foundations, in order to reduce the vibration due to the operation of the stamps. They are of squirrel-cage construction and are operated by auto starters equipped with low-voltage and overload-release coils. This type of drive has several advantages over the older method of driving an entire mill of 20 to 40 stamps by a single motor. One of the most obvious of these is the fact that any 10 stamps can be hung up during a clean-up. Thus, when anything arises whereby the operator needs to make adjustments or any changes in a particular battery, it can be shut down and the work done without any chance of the operator being injured.

In former times the important feature was to obtain an installation that was mechanically right, and nothing else seemed to matter. Now, however, efficiency is taken into account, and it can easily be shown that different types of drives, whereby a 1- or 2-% increase in efficiency can be obtained, will warrant their installation. For example, the saving of 1% in a stamp-mill drive would mean a saving in a year's operation of this particular mill of approximately $120. In this particular instance it is estimated that a saving of about 5% was made when the mill was changed to this character of drive.

Norwegian Copper and Pyrites

A review of the copper and pyrites industry of Norway since the beginning of the European War is published by *L'Echo des Mines*. The Sulitjelma mine, in spite of many difficulties, produced a little more in 1914 than in 1913; the output being 125,600 metric tons of pyrites of export grade, 12,960 tons of smelting ore and 13,380 tons of Elmore flotation concentrates carrying 7.11% of copper; or a total production of 151,940 tons. There were smelted locally 27,075 tons of pyrites and concentrates, yielding 1,475 tons of bessemer copper. The new installations, as well as the works of modernization, are about completed; the mineralization in the mine is still good; and further increase of production contemplated. The number of employees in 1914 was about 1,667, of whom 632 worked underground. In 1915 the exploitation was about normal, with an output of 139,445 tons of export pyrites, 12,325 tons of smelting ore, and 14,719 tons of Elmore flotation concentrates carrying 7.43% copper; or a total output of about 166,489 tons. There were smelted 11,370 tons of pyrites and 13,611 tons of concentrates, which gave 1,434 tons of bessemer copper. There were 1,690 workmen employed in 1915, of whom 757 worked underground.

The Bossmo mines were shut down provisionally about the end of July, 1914, on account of the war; but reopened on a small scale in November, 1914, with about 100 workers. There was a production of 15,000 tons in 1914 and 21,000 tons in 1915 of export pyrites, or nearly the normal output of 25,000 tons.

The Birtavarre mine, situated at Lyngen, began producing in 1910. It yielded about 450 tons of bessemer copper in 1914 and 486 tons in 1915.

The Lökken mines (Orkla Mine Co.) exported in 1914 about 69,370 tons of washed pyrites, 64,827 tons of pyritic lump ore and 5,925 tons of copper ore; while in 1915 there were produced and exported 68,822 tons of washed pyrites and 108,611 tons of pyritic lump ore, or a total of 175,433 tons with 580 workers. Additions are being made to the plant, in order to increase production.

The Rőros Kobberverk (organized in 1644 A. D.) increased its production from 493 tons of fine copper and 7,700 tons of export pyrites in 1914, to 625 tons of copper and 8,500 tons of pyrites in 1915.

The Röstvangen Gruber produced 18,025 tons of export-grade pyrites in 1914, of which 10,609 tons were exported. The average content was 2.75% Cu and 43% S. The concentrator having been completed, the production in 1915 was 8,244 tons of lump pyrites, 5,424 tons of washed pyrites and 620 tons of high-grade lump. From 500 to 550 men are employed.

The Foldal Copper & Sulphur Co., Ltd., produced 68,000 tons of pyrites in 1914 with 424 employees; and it is believed that the 1915 production was much larger. The Killingdal mine in Aalen (operated under lease by the Bede Metal & Chemical Co., Ltd.), produced about 17,568 tons of export pyrites in 1914 and presumably the same quantity, or slightly more, in 1915. The Kjőli mines, formerly worked by Belgian capital, suspended operations immediately after the outbreak of the European War; but will be taken over and operated by other interests. The Grong mines, operated by French capital, continued exploration and development work; but the transportation question has not yet been solved.

The Stordő mines produced in 1914 about 58,255 tons of crude pyrites yielding, after concentration, 26,400 tons of export grade; nearly half of which was exported. In 1915 the yield was 36,281 tons of export pyrites, with a force of 170 employees. The Svano mines produced about 8,000 tons of pyrites annually in 1914 and 1915, with 70 men; and at the Karmo, Rődfjeld, Fosdalen, Undal and Meraker mines there was a slight production during 1915. At the Bjőrkaasen mines some tonnage of pyrites has been blocked out and work has been conducted on a small scale, but on account of the war the projected plant was not constructed.

The total copper production of Norway in 1914 is placed at 2,860 tons of fine metal, including 400 tons produced at the Christiansaand nickel refinery; while that of 1915 is estimated as 2,850 tons, being about 100 tons more than in 1913.

The 1914 pyrites production was about 420,000 tons, of which 360,000 tons were exported and the remainder consumed in Norway. In 1915 the pyrites production amounted to 525,000 tons, of which 460,000 tons were exported. Since the beginning of the European War nearly half of the Norwegian pyrites production has been exported to Sweden—probably 200,000 tons annually—chiefly because of the difficulty of moving the usual supply of Spanish pyrites to Sweden.

The total value of copper and pyrites production, at Norwegian ports, amounted to about $4,000,000 in 1914 and about $7,000,000 in 1915; the selling price being higher during the latter year.

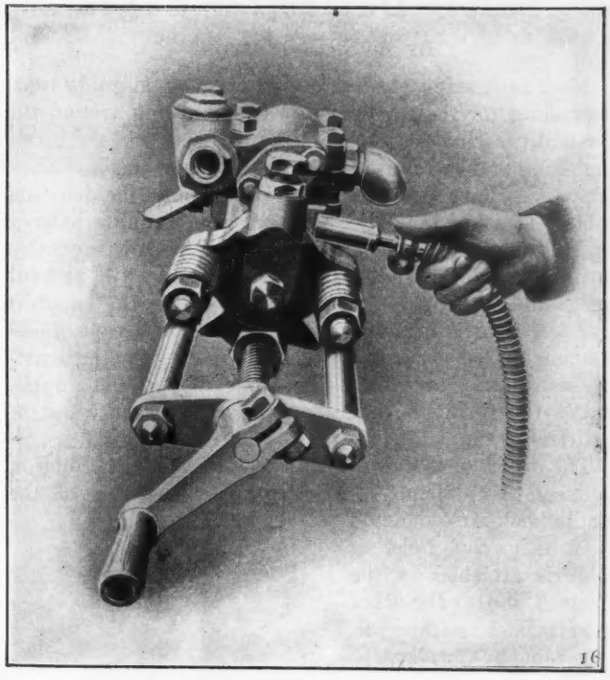
⁂

Calcium Carbide Manufacture in Norway is attracting American capital, according to Maurice P. Dunlap, the American consul in the district of Stavanger. A large plant is being built at Saude by the Electric Furnace Products Co., Ltd., a Canadian corporation with an officer of the Union Carbide Co. electric power available close to the seacoast being 40,000 hp. By carrying the tail water nearly 5 mi. through the mountains another 40,000 to 45,000 hp. may be generated by the fall into the fjord. A new village is being made in the valley at the end of the fjord near the factory. Although 70 mi. from the sea, the water of the fjord is so deep that large ocean steamers can come direct to the docks at the factory. Rails, locomotives, cars, cranes and steelwork which cannot be obtained in Norway have been ordered from the United States.

Holman Hammer Drill

By E. M. Weston*

A large number of drills have recently been designed on the lines of the Leyner drill. The drawing shows the one made by Messrs. Holman, of Cornwall. The chief feature of interest to American miners and designers is



HOLMAN HAMMER DRILL

the simple and strong valve action in which the valve is always thrown over with live air. Another feature is the neat manner in which the water hose is attached, by a kind of setscrew, to the machine.

⁂

Prospecting for Potash in Texas

Washington Correspondence

Drilling will begin in a few days on the well being sunk by the United States Geological Survey in Collingsworth County, Texas, to prospect for potash. The drilling is being done near Clifford, about 75 mi. east of Amarillo. Last year the well was drilled to a depth of 362 ft., when it became necessary to suspend the work, owing to the exhaustion of the appropriation.

Since the new appropriation became available, great difficulty has been experienced in securing pipe and other equipment. There is now approximately $10,000 available for the prosecution of the drilling. Over the Red Beds series, in which it is hoped to find potash layers, there is a capping of Tertiary and Triassic formations. There still is assumed to be about 100 ft. of capping to be penetrated before salt-bearing formations may be expected. The work is being done by churn drill. Owing to the correspondence in character of this area with that in which the German potash deposits are laid down, there are hopes that this prospect may develop the presence of potash in soluble form.

*The Randfontein Central Gold Mining Co., Ltd., Millsite, Transvaal, South Africa.

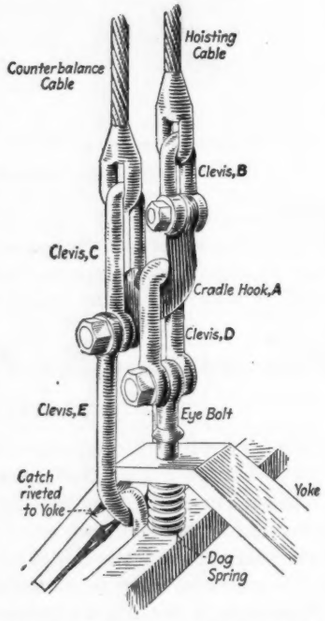
Details of Practical Mining

Safety Device for Cages

By A. S. Livingston*

Most cage safety devices are of the dog-on-guide type, depending for their action on a coiled spring around the eye-bolt, which is held compressed by tension in the hoisting cable and is released in case the cable breaks. Such appliances have positive action when only the hoisting cable is attached to the eye-bolt, but when a counterbalance rope is also attached thereto, in case the hoisting cable breaks, tension in the counterbalance cable will prevent quick and positive action of the dogs. If the counterbalance cable is attached to the yoke of the cage, independent of the eye-bolt, insufficient tension in the hoisting cable may allow the dogs to catch on the guides, unless the spring is made very weak, and hence not of positive action.

The device here shown was developed by G. M. Robison to meet this difficulty. It is simple, consisting of the cradle hook *A* to one end of which the hoisting cable is attached by the clevis *B* and to the other is attached counterbalance cable by the clevis *C*. A third clevis *D* hangs in the cradle hook, and from it the cage is suspended in the usual manner. A fourth long clevis *E* is attached to the same bolt that holds the clevis *C* and hangs down around the yoke of the cage, engaging a hook, with about an inch free play vertically. If the hoisting rope breaks, the cradle hook turns over, putting the weight of cage, through the clevis *E*, entirely on the counterbalance cable, at the same time releasing the dog spring and allowing the dogs to grip the guide. If the counterbalance cable breaks first, the weight goes on the hoisting cable direct, still holding the dog spring compressed. If the hoisting cable now breaks from the suddenly added strain, the dogs are free to work in the usual manner. At the same time the whole weight of the cage is effective to hold the dog springs at all times compressed.



A POSITIVE-ACTING SAFETY DEVICE FOR CAGES

When the cage is empty, it is nearly in balance and the cradle hook takes an angle of slightly less than 45° from the horizontal; when loaded, it assumes the upright position shown in the drawing. The device has been in operation for some weeks and has been repeatedly tested by putting a trip in the hoisting cable and then suddenly severing connections. Action has always been quick and positive, the maximum free drop of the cage before it was caught and held by the dogs being 2 in. Tests were made with a loaded car on the cage, probably weighing from 2,800 to 3,000 lb.

*Mine inspector, Detroit Copper Mining Co., Morenci, Ariz.

Reducing Air-Drill Repair Costs

By Frank Ayer*

Important factors in repairing air drills are speed and economy. The average company has too few extra drills, so that speed on the part of the repair man is necessary to keep the drills underground. If he has extra parts on hand, he has only to replace a broken or worn piece with a good one and the drill can be quickly returned to the mine. When all the drills have left the shop, he can repair the disabled parts so that corresponding new parts will be unnecessary for machines that come in later.

The following repairs and replacements can be made to good advantage. Observe the comparison of prices f side rods and bolts:

	Size	Cost, Each	Cost of Machine Bolts, Same Size
No. 18 Leyner through bolts.....	⅝x25-in.	$1.00	$0.11
C-110 piston-drill through bolts..	⅝x20-in.	.48	.10
BC-21 feed-cylinder bolts and nuts	⅝x 9-in.	.90	.045
BC-21 front-head bolts and nuts..	⅝x 6-in.	.86	.04

The drills mentioned are Ingersoll-Rand. The worn or broken Leyner through bolts may be rethreaded and used as C-110 through bolts. The worn C-110 through bolts are made over into BC-21 feed-cylinder bolts, which finally are made over into BC-21 front-head bolts.

In some mines, with the proper ratio of Leyner No. 18 drills to the other types mentioned, the number of Leyner through bolts broken is sufficient to keep the other drills supplied. In case there are not enough of the Leyner bolts, common machine bolts may be bought at the prices given. They do not wear quite as long as the corresponding bolt sold by the drill company, but have been found more economical.

Repairing a Rotation Sleeve

The rotation sleeve, which holds and turns the drill, wears rapidly. When it is badly worn, the steel enters the sleeve diagonally and in turning, the shank end of the steel has an eccentric motion which quickly wears off or breaks the water tube. The piston does not hit the drill squarely and is worn and chipped off on the sides. It is an expensive part ($10 each), and the average repairman leaves it in too long, causing additional cost for piston and water tube, and increasing the operating costs.

The rotation sleeve is repaired as follows: An old pair of Leyner drill-sharpener dies are bored as shown in Fig. 1. A ½-in. wooden spacer is placed between

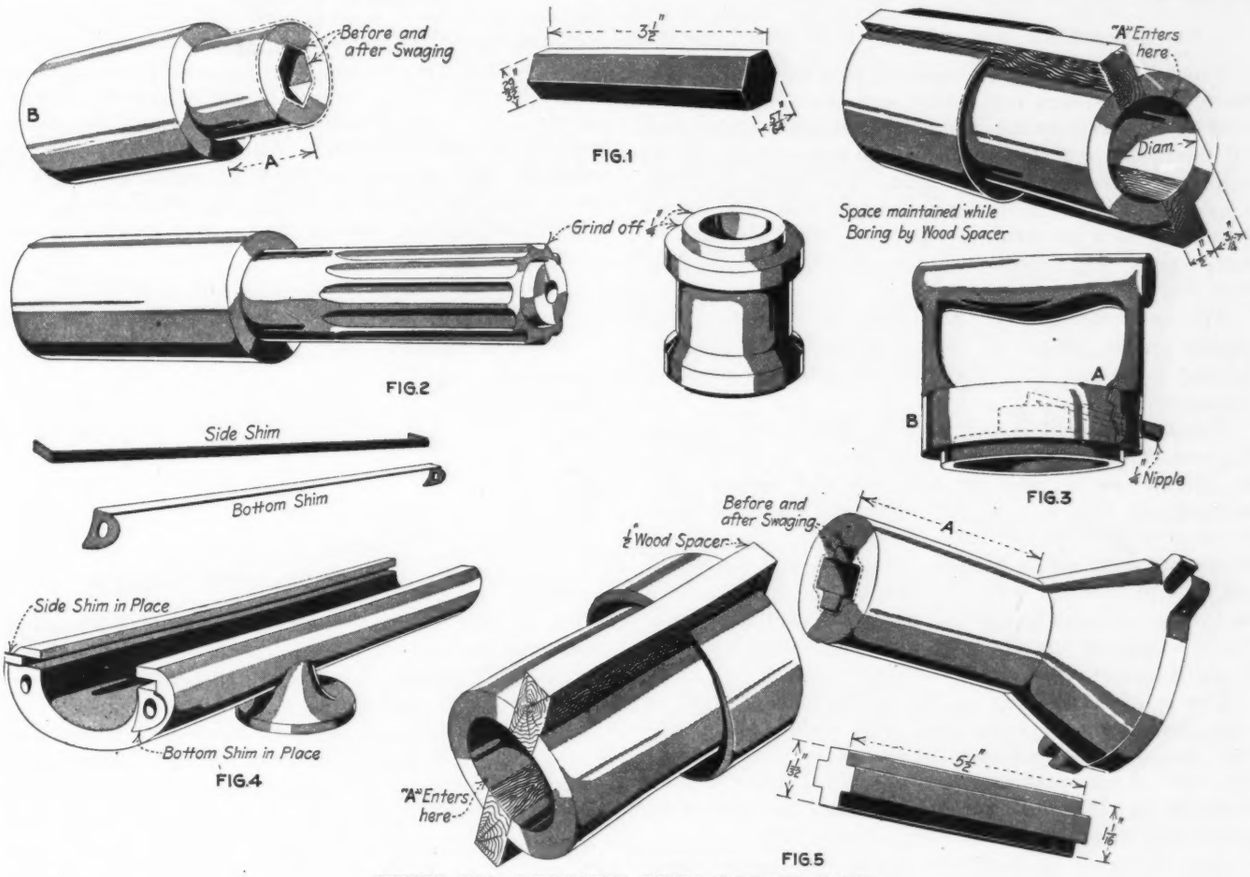
*Mine foreman, Detroit Copper Co., Morenci, Ariz.

the dies and a 2-in. hole drilled. When the spacer is removed, the opening in the dies has an elliptical section with a short diameter of 1½ in. and a long diameter of 2 in. This gives the metal space in which to flow during the first few blows of the swaging operation.

The worn rotation sleeve is heated and upset enough to maintain the proper length after swaging. This could be done by gripping in the sharpener and upsetting with a blind dolly, but is an unnecessary refinement. A few blows on the end with a flatter and hammer are sufficient.

head cracking inside the standard and down through the water opening. The threads can be tapped out once or twice for a little larger nipple. When there is not enough stock left to tap and rethread, the opening is plugged and a new one drilled and threaded in the opposite side of the handle.

When the handle is cracked inside the standard, as shown at *A*, Fig. 3, a long hole is drilled and tapped for a ¼-in. nipple. This allows the water to be introduced beyond the crack, making the handle good for



KINKS FOR REDUCING DRILL-REPAIR COSTS

A hexagonal mandrel $\frac{23}{32}$ in. diameter is inserted in the hot rotation sleeve and the sleeve swaged down in the drill-sharpener dies. The mandrel has a slight taper so that it can be more easily driven out. A cold piston may be inserted at *B* to turn the hot sleeve while swaging.

In mines where there is no sharpener, dies can be made to perform the same work by hand. After heating to a dull cherry red, the sleeve is tempered in oil. This operation requires a half-hour and makes a sleeve as good as new. Several repaired rotation sleeves should be kept ready to replace those showing slight wear. This helps materially to keep the machines underground.

A piston, chipped off on the sides or worn, ruins the drill shanks. Pistons cost $12.75 each. Their life can be nearly doubled by annealing, grinding ¼ in. off the end and retempering. To keep the piston stroke the same, ¼ in. is faced off the lower end of the front-head washer, as shown in Fig. 2. This repair can be made in three hours.

Handles have to be replaced at a cost of $4.79 on account of the water-connection threads wearing and the further use. One hour is sufficient for either of these repairs.

A good tube can be made by brazing two old ones. The process of brazing is as follows: A $\frac{5}{32}$-in. hole is drilled ⅜ in. deep in the end of one old tube, and another tube is filed to fit into the drilled hole. Both ends are then heated to a white heat, spelter applied, and the joint made. The brazed tube is cut to proper length and the end entering the drill steel tapered and tempered. The brazed tubes give good satisfaction. They do not break at the joint but, like new water tubes, wear off on the end.

The No. 18 Leyner water tubes are 18¾ in. long, and the Jackhamer water tubes are 14⅞ in. long. Hence broken or worn Leyner water tubes may be cut to proper length, tapered, tempered and used as Jackhamer water tubes. The slight difference in their diameters does not affect their usefulness.

Another way to save money is to buy the water tubing at 7c. per ft. and make your own tubes. Water tubes cost 61c. while the same length of tubing costs 9c.

The steel holder wears where it comes in contact with the drill until it slips over the collar on the drill shank. The end can be heated, closed up a little, and tempered at a dull cherry red in oil. Half an hour makes the repair. The part costs $2.

After annealing, the rifle bar and piston from a dry Jackhamer can be drilled with a $\frac{9}{32}$-in. drill to allow the water tube to pass through. They are then tempered and are ready for use in the wet machine.

In the C-110 piston drill the side wear on the cylinder guides and shell is taken up by side shims.

Repairing Front-Head Bushings

Front-head bushings are made of steel or bronze. The worn steel bushings are heated and closed up in a vise enough to make up for wear. One-eighth inch is filed off the collar so a thin shim may go over it and still fit into the groove in the front head. The bronze bushings are easier to repair, as the collar can be filed in a shorter time and does not require heating. They also have a scrap value. The bronze bushings cost $3.52 and the steel ones $3.40.

The water tubes in the No. 18 Leyner are made from tubing or are brazed as mentioned under Jackhamers. Leyner tubes cost 61c., while a corresponding length of tubing costs 12c.

The Leyner shell is not provided with shims to take the bottom wear of the cylinder guides as the C-110 drill is. Shims can be made for both side and bottom wear, as shown in Fig. 4. The side shims are simply straight strips bent back on each end of the shell. The bottom shims are long strips of thin iron bent and shaped at the ends to conform with the lines of the shell. At the back they are held by the two standards, while in front, $\frac{5}{8}$x2-in. bolts are used. Both classes of shims are made in $\frac{1}{32}$-in., $\frac{1}{16}$-in., and $\frac{1}{8}$-in. thicknesses.

The cylinder bushing in the BC-21 stoper drill is often broken off by chips from the anvil block or the drill shanks. The part costs $4.50 and is often replaced too soon. A few small pieces broken off the upper portion do no harm. It is not necessary to change this part until nearly half of the upper portion is broken off.

When the anvil block chips, wears or cups in the center, it can be faced off on the emery wheel in 15 min. and the saving amounts to $1.70.

The BC-21 front head wears rapidly because it takes the wear of turning the steel. Old drill-sharpener dies are bored for swaging this part, as shown in Fig. 5. Upsetting is unnecessary. The part is allowed to elongate, as the length has no effect upon the stroke and the longer front head gives more wearing surface for turning the drill steel. The swaged front head is heated to a dull cherry red and tempered in oil. With the proper dies and mandrel on hand, this repair can be made in 30 min. at a saving of $5.

Vibration causes the two heads on the feed piston rod to work loose. They can be made fast again by making new punch marks in the rod over the countersinks in the heads. They can also be brazed. The feed tailpiece becomes blunt and can be repointed on the emery wheel. The point should not be too sharp, as occasionally a careless miner turns on the air with the tailpiece over his foot.

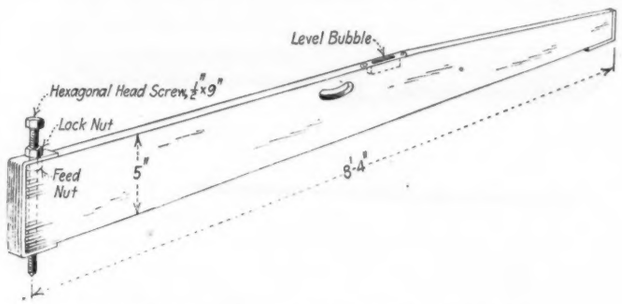
Top bushings can be bought for feed cylinders, but no bottom bushings are available. When the bottom bushing wear and become loose, it is not necessary to buy a new cylinder costing $13. A new bushing is cheaply made in a lathe and brazed into the lower end of the feed cylinder.

The air-drill repair man who is constantly on the lookout can repair enough worn and broken parts to cut repair costs in two. It should be borne in mind, however, that the use of any old part that delays the operator or reduces drilling efficiency is poor economy.

An Adjustable Grade Templet

By F. T. Teddy*

I have found the track-grade templet herein described and shown to serve admirably the purpose for which it was designed, particularly because of the adjustable feature embodied in it. As the illustration indicates, it is made from 1¼-in. material such as yellow pine. The ends are protected from wearing by strap-iron shoes, the holes in which are countersunk to receive the wood-screws that secure them in place. One of these is bent around the end



A CONVENIENT TRACKLAYING TEMPLET

of the templet in order that the nut of the adjusting screw may be held in place. Inexpensive level-bubbles may be easily procured, and one of these can be secured in a recess in the wood by means of plaster of paris.

In use all that is necessary in order to establish any desired grade is to extend the screw through the necessary amount. Thus for a 1% grade the screw is extended through 1 in., for a 2% grade, 2 in., etc. A screw that will admit an extension of 3 in. is sufficient for all ordinary purposes. While this idea does not follow strictly the trigonometric principle, I believe it is sufficiently close for all practical purposes.

A Canvas Ditty Bag

Sailors are renowned for their ability to change ship quickly and with the least amount of baggage. They usually have a chest and a ditty bag and that's all. The latter piece of baggage is interesting to the engineer prospector, as it fits into his scheme of mobile equipment perfectly. As usually made it is cylindrical, about 1 ft. in diameter and 3 ft. high and made of heavy canvas with a double top. Small loops on the bottom and sides permit its attachment to the back of man or animal—as circumstances demand. Its volume is sufficient to contain a blanket roll and the personal effects of the user. It is waterproof and can be stowed in a variety of places depending on its packing. Its use as a sleeping bag for the owner's feet when they stick out of the end of a shelter tent has been known.

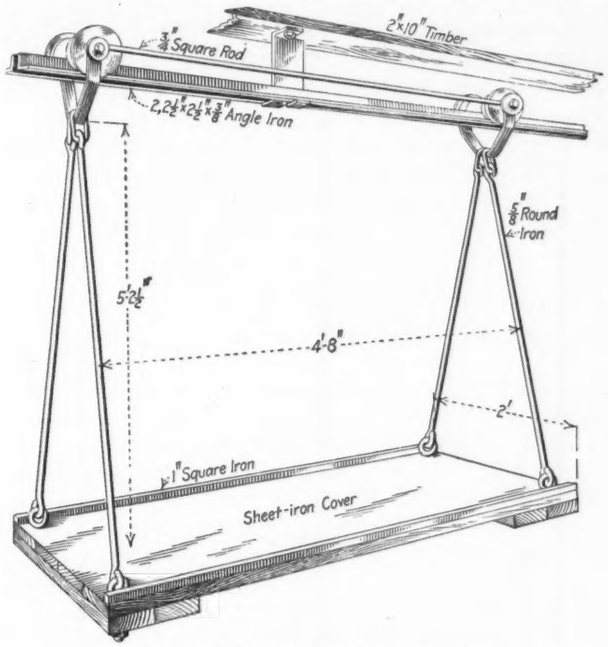
*Mining engineer, Ducktown, Tenn.

Details of Milling and Smelting

Battery Carriage for Supplies

By Arthur C. Daman*

The battery carriage for battery supplies shown in the accompanying illustration was built in the shops of the Aurora Consolidated Mines Co., Aurora, Nev., and



CARRIAGE FOR BATTERY SUPPLIES

has proved to be quite a success in handling the heavy dies, shoes, bossheads and false dies to and from the forty 1,550-lb. stamps. It was designed by Mr. Coutoure, former master mechanic of the company.

Spiral Tube-Mill Feeders

By Arthur C. Daman*

With the introduction of Dorr classifiers in closed circuit with tube mills, the best method of conveying the coarse sand overflow of the Dorr to the tube-mill feed trough became a problem. In recent years the introduction of large spiral scoops on the tube mills has made it possible to wash the sand from the Dorr discharge down the incline to the feed box. But here the question of water regulation enters. Too much water means the rushing of feed material through the mill with no apparent grinding, and too little water threatens us with an overloaded tube mill.

As the maximum efficiency is determined by a certain pulp consistency, it behooves us to get the best regulation of pulp feed. This is obtained with spiral feeders that can be connected to the Door-classifier driveshaft by a chain drive. At the discharge end of the spiral feed, the necessary amount of water to keep the proper consistency can be added. With the use of spiral feeders, the frequent shoveling and flushing down of accumulated sands at the end of the Dorr classifier is avoided. The spiral feeders used at the Nevada Packard mill have a life of 7 months, or about 20,000 tons conveyed, with an original cost of about $25. The power cost for the spiral is negligible.

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Sizing Flotation Concentrates

Some experiments on the screen analysis of flotation concentrates have been made by Charles Y. Clayton, of the School of Mines and Metallurgy of the University of Missouri, and are published in the school *Bulletin* for August, 1916. In carrying out the experiments the flotation concentrates obtained from previous tests were diluted with water and run through a set of Tyler standard screens. The material upon each screen was dried and assayed. In making the screen analysis, the dilute pulp passing through 260-mesh was put in large pans and agitated by stirring with a spatula and allowed to settle for about five minutes, when the water and unsettled slime were decanted and dried. The material poured off is classed as 260a, while the material remaining in the pan is classed as 260b.

The concentrates for experiments 1 to 4 inclusive, were obtained on a standard Callow pneumatic machine, that for experiment 5 in a Minerals Separation machine and that for experiment 6 from an actual flotation plant. The pulp ratio was 5 to 1. The oils used for obtaining the concentrates were as follows: In experiment 1, oil from water-gas tar four parts, and a solution of Fairbanks glycerin soap (5 grams of soap to 100 c.c. of

EXPERIMENT NO. 1

Through Mesh	On Mesh	Average Diameter, Mm.*	Wt., Grams	Pb, %	PbS, Grams	Gangue, Grams by Difference	Gangue, per Cent. Total
65	80	0.187	25.70	79.40	23.50	2.20	1.26
80	100	0.161	40.90	79.20	37.30	3.60	2.06
100	115	0.135	44.40	78.40	40.00	4.40	2.52
115	150	0.114	25.90	74.20	22.10	3.80	2.18
150	170	0.096	26.00	75.40	22.50	3.50	2.01
170	200	0.081	13.30	70.20	10.70	2.60	1.48
200	260	0.065	22.50	68.20	17.60	4.90	2.81
260a			117.90	60.40	82.00	35.90	20.50
260b			143.20	18.05	29.65	113.50	65.90

*The average diameters of particles in all the experiments were indentical with those in experiment 1.

EXPERIMENT NO. 2

Through Mesh	On Mesh	Wt., Grams	Pb, %	PbS, Grams	Gangue, Grams by Difference	Gangue, per Cent. Total
65	80	5.00	63.40	3.67	1.33	0.72
80	100	19.50	75.40	16.35	3.15	1.70
100	115	6.70	74.00	5.72	1.00	0.54
115	150	15.60	76.00	13.69	1.90	1.05
150	170	10.40	76.40	9.17	0.66	0.36
170	200	21.00	74.20	18.00	3.00	1.62
200	260	17.20	70.40	13.98	3.22	1.74
260a		111.00	75.00	95.45	15.55	8.40
260b		234.20	29.20	78.95	155.25	84.00

EXPERIMENT NO. 3

Through Mesh	On Mesh	Wt., Grams	Pb, %	PbS, Grams	Gangue, Grams by Difference	Gangue, per Cent. Total
65	80	21.00	76.00	18.43	2 57	1.18
80	100	58.30	77.60	52.23	6 07	2.79
100	115	53.30	78.20	48.12	5 18	2.38
115	150	30.00	65.60	22.72	7 28	3.35
150	170	35.00	67.80	27.40	7 60	3.50
170	200	35.50	64.70	26.52	9 98	4.13
200	260	43.10	55.70	27.72	15 38	7.08
260a		170.00	67.00	129.40	40 60	18.70
260b		178.00	26.90	55.28	122.72	56.40

water) one part; experiment 2, pine oil No. 6 of General Naval Stores Co.; experiment 3, oil of citronella, prepared by McKesson & Robbins; experiment 4, flotation oil No. 17 of the General Naval Stores Co., and in experiment 5 the same agent; experiment 6, creosote oil No. 2, of the Cleveland Cliffs Iron Co. The quantity of oil was not recorded, the amount used being enough to give a good froth. The original concentrates were obtained from a dolomite lead ore. The results are shown in the accompanying tables.

These experiments show that the percentage of gangue material floated is greatest for the finest material. In experiment 1 the material through 260a assays only

EXPERIMENT NO. 4

Through Mesh	On Mesh	Wt., Grams	Pb, %	Zn, %	PbS-ZnS, Grams	Gangue, Grams by Difference	Gangue, per Cent. Total
65	80	13.20	4.80	32.00	6.38	6.82	3.92
80	100	29.50	26.80	33.40	23.32	6.28	3.60
100	115	33.00	39.80	22.20	24.95	8.05	4.60
115	150	13.50	36.20	19.40	9.14	4.36	2.50
150	170	19.20	40.20	13.20	12.32	6.88	3.95
170	200	39.10	47.60	9.70	26.55	12.55	7.22
200	260	33.20	46.40	9.30	21.90	11.29	6.48
260a		111.37	40.40	9.25	91.44	19.93	11.45
260b		336.70	26.26	7.95	138.90	97.80	55.80

EXPERIMENT NO. 5

Through Mesh	On Mesh	Wt., Grams	Pb, %	PbS, Grams	Gangue, Grams by Difference	Gangue, per Cent. Total
65	80	0.00	0.00	0.00	0.00	0.00
80	100	4.40	40.00	2.22	1.78	0.22
100	115	27.10	76.20	23.70	3.40	0.43
115	150	36.90	72.20	30.60	6.30	0.80
150	170	25.00	77.80	22.36	2.64	0.35
170	200	34.60	76.40	30.80	3.80	0.48
200	260	35.50	71.80	29.30	6.20	0.49
260a		21.50	80.20	19.80	1.70	0.21
260b		1,080.00	25.80	320.40	759.60	96.60

DATA, FROTH FROM A MILL

Through Mesh	On Mesh	Wt., Grams	Pb, %	PbS, Grams	Gangue, Grams by Difference	Gangue, per Cent. Total
65	80	0.00	0.00	0.00	0.00	0.00
80	100	6.10	41.40	2.90	3.20	0.79
100	115	0.00	0.00	0.00	0.00	0.00
115	150	4.60	33.40	1.80	3.80	0.95
150	170	5.15	31.60	1.90	3.60	0.89
170	200	0.00	0.00	0.00	0.00	0.00
200	260	7.50	46.80	4.00	3.50	0.86
260a		105.00	62.40	75.40	29.60	7.30
260b		834.00	49.30	472.50	361.50	89.20

18.05% lead and contains 65.90% of the gangue floated. Experiment 2 gave material through 260a of 29.2% lead containing 84% of the total gangue material floated. The same material in experiment 3 assayed 26.9% lead and contained 56.4% of the total gangue floated. In experiment 4 this product assayed 26.26% lead and contained 55.80% of the total gangue. In experiment 5 this product assayed 25.8% of the lead and contained 96.6% of the total gangue.

Experiment 5 shows less of the coarse gangue material floated than any other. This concentrate was made on machine No. 3, which allowed the coarse gangue material to settle to a certain degree. In experiment 6 there is shown a low percentage of material on the coarse mesh, due to the fact that the original flotation feed showed a high percentage of fine material.

The Properties of Globular Agglomerates

The manufacture of globular agglomerates is discussed by C. A. Brackelsberg in *Zeit. fur angew. Chem.*, No. 29, 1916, and reviewed in the *Journal* of the Society of Chemical Industry. According to this report, the agglomerates are produced in a plant consisting of a mixer, an agglomerating drum and a drier. They may be made from almost any powder and any solution which crystallizes out or leaves a crusty residue upon evaporation. The finished product consists of balls that resist crushing, yield very little powder on breaking and possess a high degree of porosity due to evaporation of the liquid. Hence the action of gases, such as occurs in roasting and smelting is much more rapid and thorough than on briquettes or sintered products. Copper, lead, bismuth, antimony, gold, silver and zinc may be volatilized by the action of hydrochloric-acid gas on agglomerates containing them, and thus be separated from iron, manganese and nickel.

A Belt Length Chart*

By W. F. Schaphorst†

The accompanying chart is useful when it is required to find out the number of feet of belting in a roll. The distance X must be measured, as shown, in inches. For

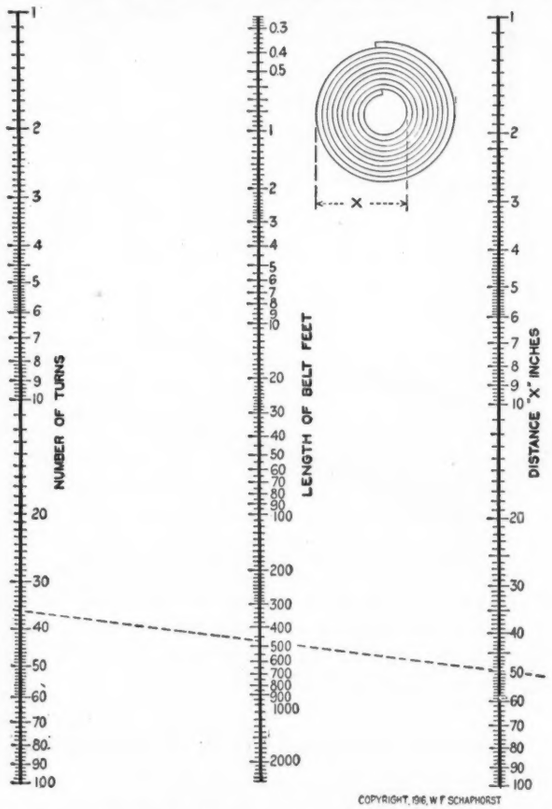


CHART FOR DETERMINING LENGTH OF ROLLED BELT

example: How long is the belting in a roll that has 36 turns, the distance X being 50 in.? The dotted line drawn across the chart shows how easily the length is found; it is 470 ft. It will be observed that the range of the chart is great and will easily cover any ordinary roll.

Electric Furnaces in Sweden are now producing over 100,000 tons of steel yearly, according to J. O. Boving in the London "Iron and Coal Trades Review." The process has now been developed so that molten pig is delivered direct to the open-hearth furnaces which are heated by gases from the reduction furnaces. The liquid charge from the open-hearth furnaces is transferred to an electric refining furnace. The final steel is reported to be of remarkably high quality. Mr. Boving says this is plainly the right method where electric current can be obtained at a reasonable price.

*Copyright, 1916, by W. F. Schaphorst.

†Mechanical engineer, Woolworth Building, New York.

Correspondence and Discussion

Mining Law Revision

I have read with interest the discussions on the proposed changes in the mining laws of the United States with reference to the staking of mineral lands. Most of the suggestions made have come from prominent engineers, and their views are conflicting. It occurred to me that 13 years of actual prospecting, coming in contact with different mining laws, might make the views of a prospector of some value in the discussion.

I am of the opinion that the requiring of a "discovery" either before staking or before the issue of a patent is a mistake and a hardship on the prospector. Take the hypothetical case of a drift or swamp-covered area lying between or near known deposits of valuable mineral. It might be impossible for the prospector with his limited means to make a discovery, yet he has absolute faith in the continuation of the deposit under the swamp or glacial drift and is willing to spend his time and best efforts there.

Who should be the judge of what constitutes a valid discovery? Doubtless there is a multiplicity of judical decisions on this point, but the best judge is the prospector who stakes. The claim is valuable in his eyes, and he is the one who is to back his views with his work, and if he earns his patent by his labors, the claim should be his regardless of the views of one sent to inspect his discovery as to its sufficiency.

I feel very strongly on another point. There should certainly be an appeal from the land office to the courts on any question of rights under the act, or of disputed facts or on interpretation. Regardless of the possible delays and cumbersome procedure of some courts, any prospector would rather have his day in a real court of law than submit his rights to the final determination of any administrative officer.

Assessment work should be based on the number of days' work alone, not on the amount of rock broken or yardage stripped. The hardness of rock is too variable to work out an equitable system on that basis. Money should never be taken in lieu of assessment work. A bona fide prospector will always do his work with the consequent improvement of his property rather than pay the cold cash to the government. Certainly money payments retard the development of a mining district and would rarely be resorted to except by large interests.

The best acreage for a mining claim is 40, and in surveyed territory to conform to the governmental subdivision. In unsurveyed sections the claim should be as nearly 40 acres as the prospector can make it with north-and-south and east-and-west boundries, or as nearly so as he can make them with the lines and corners well marked. No one wants to stake less than 40 acres if an entire 40 is available. That acreage is needed at all mining operations for buildings, dumps, etc. In order to cover cases where land supposed to have been surveyed has not actually been surveyed or where all survey marks have been obliterated and cannot be found after the prospector has used due diligence in his search, there might be a provision in the law allowing him to stake the land as it would be staked in unsurveyed territory.

Work should be allowed to be performed on one claim on behalf of a limited number of other claims in the same group, provided that the claims are contiguous and under the same ownership.

I believe the Mining Act of the Province of Ontario, Canada, as at present administered, to be the best with which I am familiar, although it has grave faults. Among these is the loss of all rights to an unpatented claim in case of failure to renew a "miner's licence" after a certain time.

The provision to allow diamond drilling to count as assessment work according to footage is excellent. This is the only exception that should be made to the rule of all assessment-work requirements on days work.

WILLIAM E. SMITH.

Box 474, Sudbury, Ont., Canada, Oct. 20, 1916.

In looking over the discussion of the revision of the mining laws, there are some changes I might suggest. As to the time of doing annual work, most mining camps are in the mountains and I would recommend that the time be changed from midnight, Dec. 31, to July 1 at noon. The year beginning then would be better suited to everyone connected with mining. If the law should be changed, then for that year $50 worth of work could be done on or before July 1, noon. The last day of the year is likely to be cold and stormy, which makes it a hardship for re-locators or men doing their annual work, and I am sure that in many districts a great many miners lose their claims by not being able to stay or do the work at that time.

I would suggest that when an application is made for a patent and a number is given to a surveyor, the patent of that number be finished. I know of companies that made application, received their numbers, had the land surveyed and never paid any more money into the land office. They did not pay taxes, nor did they do any annual work, but they made the prospector believe the land was patented until someone went to the recorder's office and found out to the contrary.

One more suggestion: The patent application, the notice of advertisement and the notice of granting patent should be posted on the schoolhouse or post-office building by applicants. Sometimes these notices are printed in some obscure county paper and they are not seen by people who might wish to contest. If they were posted at the nearest schoolhouse or post office, everybody would be given a chance. There should be a map supplied to every postmaster of every district and it should be kept posted where it could be seen. I would suggest that the districts conform to the three or four school districts in the townships.

In the mining district here we have the towns of San José, Central, Ft. Bayard, Santa Rita, Hanover and

Fierro, and I suppose there are 3,000 mining claims recorded. If it were divided so that each town was a district by itself, the maps and other matters pertaining to them could be kept better. Instead of the mining claims being enlarged, I would make them smaller. Most mines do not cover five acres of actual mineral land. By cutting down, it would encourage more prospecting, more work and more investors. The mineral zones are nearly all covered, and if you increase the acreage, it means giving away something in which the future generations should have a share. Under the land laws of the United States, a native born has either to buy or take a desert tract which would take a lifetime to develop.

JAMES A. MCKENNA.

Hanover, N. M., Oct. 29, 1916.

Limestone Precipitation of Weak Copper Solutions

In the *Journal* of Oct. 21 I notice an article on "Limestone Precipitation of Weak Copper Solutions," in which you quote Dr. Gahl as saying: "We feel very hopeful about the success of our limestone precipitation, which, if it holds what it seems to promise, will develop into a novel feature of copper metallurgy."

It may be of interest to record that this method of precipitation is not as novel as the article in question would lead one to suppose. As far back as 1880 I had occasion to install a plant using lime as a precipitating medium, at a small copper mine in the Santa Clara district of Cuba, under rather novel conditions. The outflow on the hill side of a narrow valley, from what appeared to be an old adit which had entirely caved in, was highly impregnated with copper sulphate, the water being of a light blue color. Attempts had been made previous to my visit to precipitate the copper on scrap iron, but owing to the weakness of the solution, this method had not proved successful.

The stream bed for about half a mile below the tunnel was serpentine, and for that distance the water remained clear and limpid. Then all at once, at the intersection of another stream, the water became turbid and greenish white. Wondering what caused this change, I proceeded up the branch creek and found that for quite a distance it was running over a limestone formation. Further investigation of the water showed it to contain quite a percentage of lime and magnesia. An examination of the bed of the creek below the junction of the two branches showed a deposit several feet in thickness, of a slimy mass of a darkish brown color, carying from 22 to 26% copper.

Following up this cue with further experiments, we found that by flowing the copper-carrying water over a series of riffles made of burnt lime held in place by wooden slats, the entire copper contents were precipitated with such rapidity that no great length of flume was required, but the settling capacity had to be of considerable size, as the precipitate was flocculent and deposited slowly.

This plant was operated for some time and the slimes shipped to England averaged 23% Cu. Finally the plant was burned during the Cuban revolution.

While, of course, in the laboratory the reaction of lime on a solution of copper was well known, I believe that this Cuban installation was the first practical demonstration of the process on a commercial scale.

New York, Oct. 25, 1916. E. GYBBON SPILSBURY.

Safety for Hoist Engineers

Mr. Scott's article in the *Journal* of Oct. 21, 1916, relative to the class of hoisting engineers often found in the West is well taken and is a subject that warrants considerable discussion as well as agitation with a view to improving present conditions. This question has been brought forcibly to mind recently while endeavoring to find a competent man for the operation of a double-drum Nordberg electric hoist on a 1,000-ft. shaft where hoisting was being done from several levels. After trying four men, all of whom came well recommended, I was finally able to get a man who filled the bill.

Many of our states and large mining camps demand a certificate from an applicant before allowing him to take a hoist, and to my mind, it would be greatly beneficial if we could demand that before taking a position as hoisting engineer a man be required to present a certificate of first, second or third degree, such certificate to be issued by the state authorities only after examination or after presentation of a record of experience on certain kinds of hoists.

As an illustration, a third-class degree or certificate would be given to the operators of small friction steam hoists or single-drum gasoline hoists; a second-degree certificate to men capable of passing an examination on double-drum electric or steam-geared or friction hoists; a first-degree certificate for operators of auxiliary-controlled double- or single-drum electric or steam or first-motion hoists.

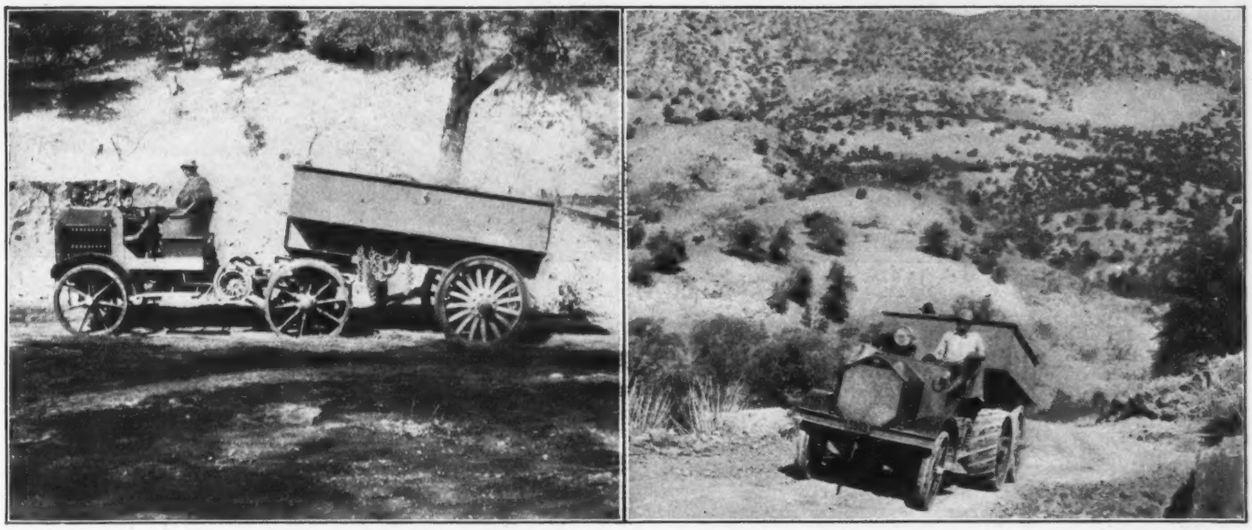
This is a field untouched in many states by the labor unions and one to which they might well look for strength, as the relation between the unions and the employers would certainly be much pleasanter if the employer knew that the union was assisting him by demanding that its members be able to fulfill certain requirements. This would result in a classification of union memberships whereby the union would resolve itself into an organization that, to a certain extent, would be an employment agency, its members classified and listed according to their requirements, capabilities, etc.

What a wonderful thing it would be if the modern mine operator, harrassed by inefficient labor, increasing costs, etc., could go to the phone and call up Mr. Moywood, the president or secretary of the local union, and ask for an A No. 1 hoisting engineer capable of handling a first-motion hoist, and receive a reply stating that just the man desired was at hand carrying splendid recommendations from past positions, etc., and that he would be up for an interview at short notice. The union man would be assured of the maximum scale of wages as set down by his union, and the employer would be assured of getting a man whose past experience had been cataloged and listed and in whom he could place confidence.

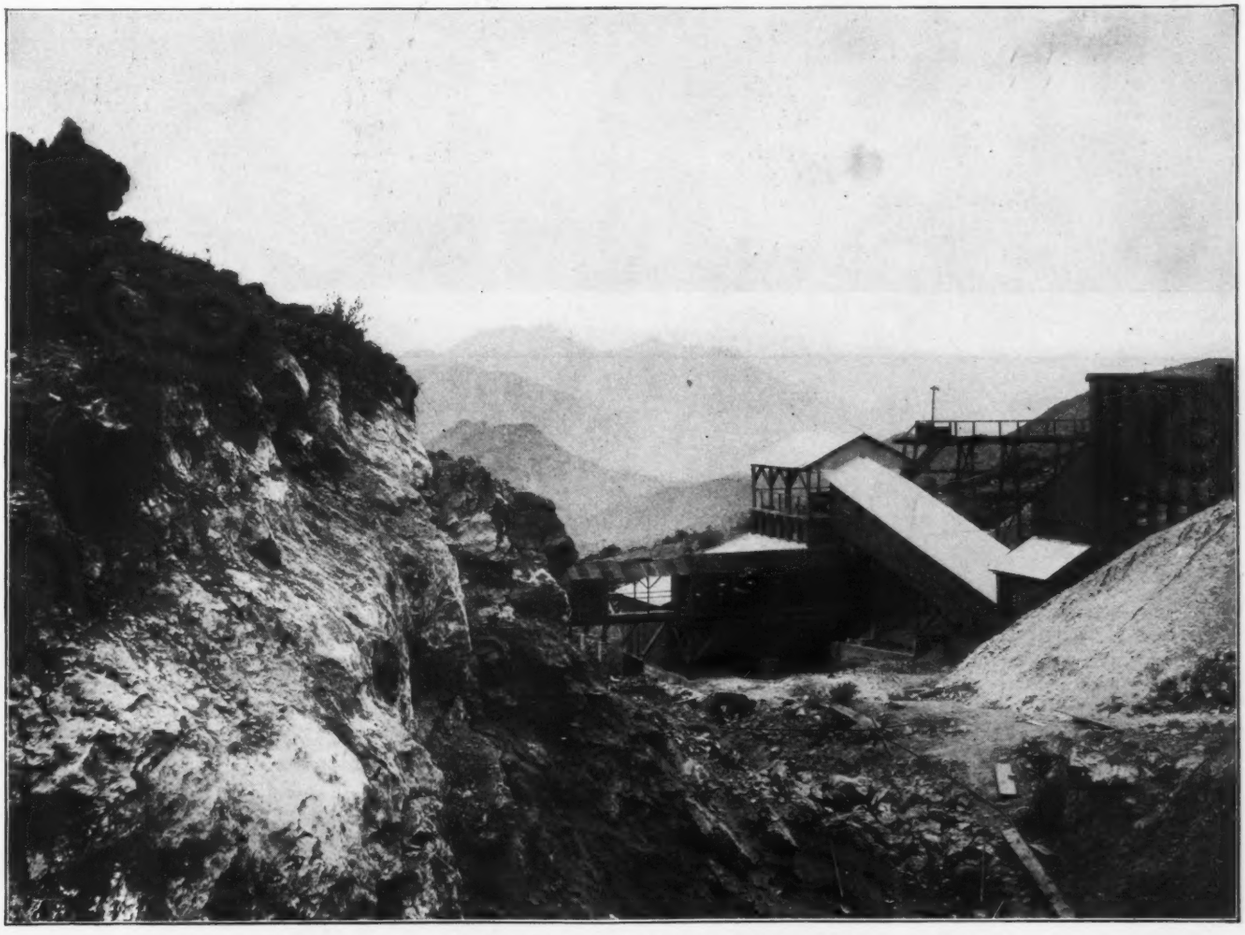
Any employer would be glad to be dictated to by a union if he knew positively that every member of that union was being dictated to by an organization that insisted that its members qualify along the lines by which they have obtained membership, thereby assuring the employer that every union man had qualified in his particular line and was a capable man. I greatly fear, however, that such ideal conditions will only be reached in the land beyond, and so we will continue to hire men on their own recommendation and, on finding them worthless, will resort to our only prerogative. W. V. DECAMP.

Mayer, Ariz., Oct. 26, 1916.

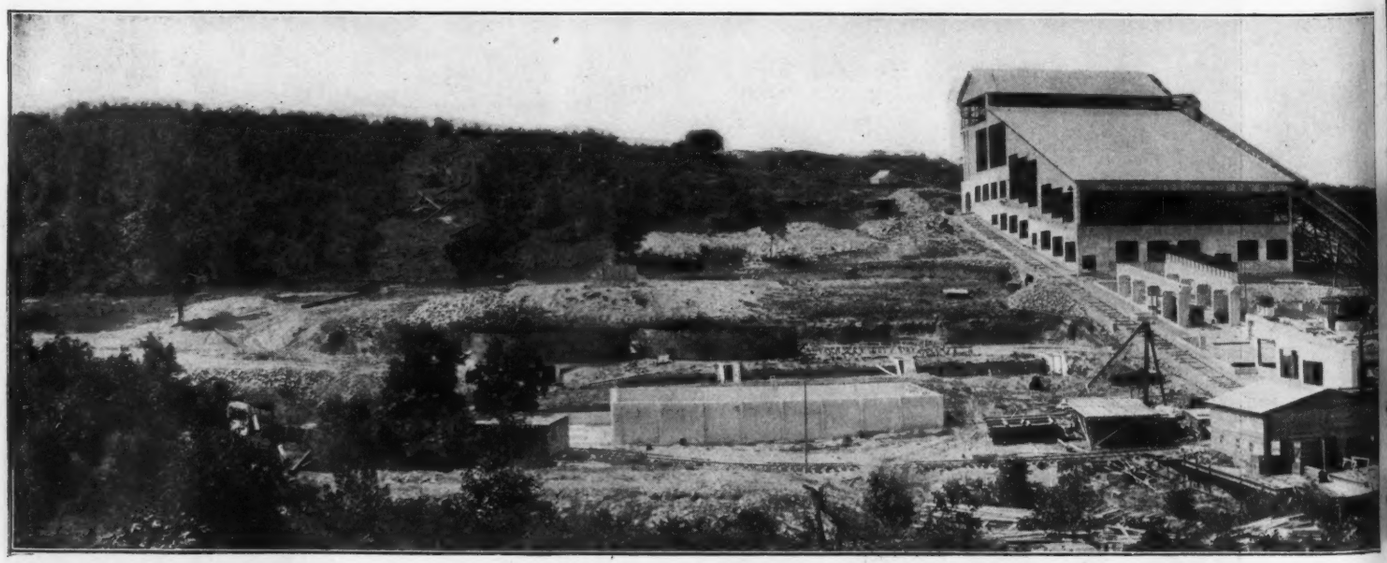
Photographs from the Field



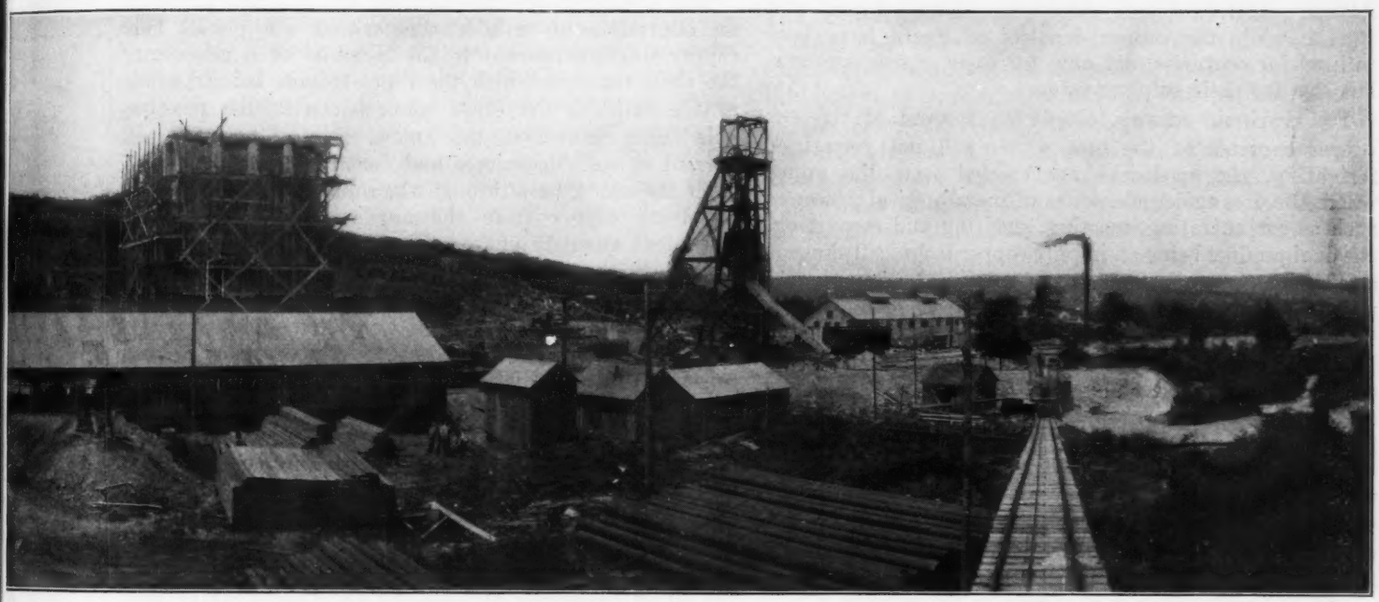
THE KNOX TRACTOR WITH SEMI-TRAILER IN USE BETWEEN DUQUESNE AND PATAGONIA, ARIZ.

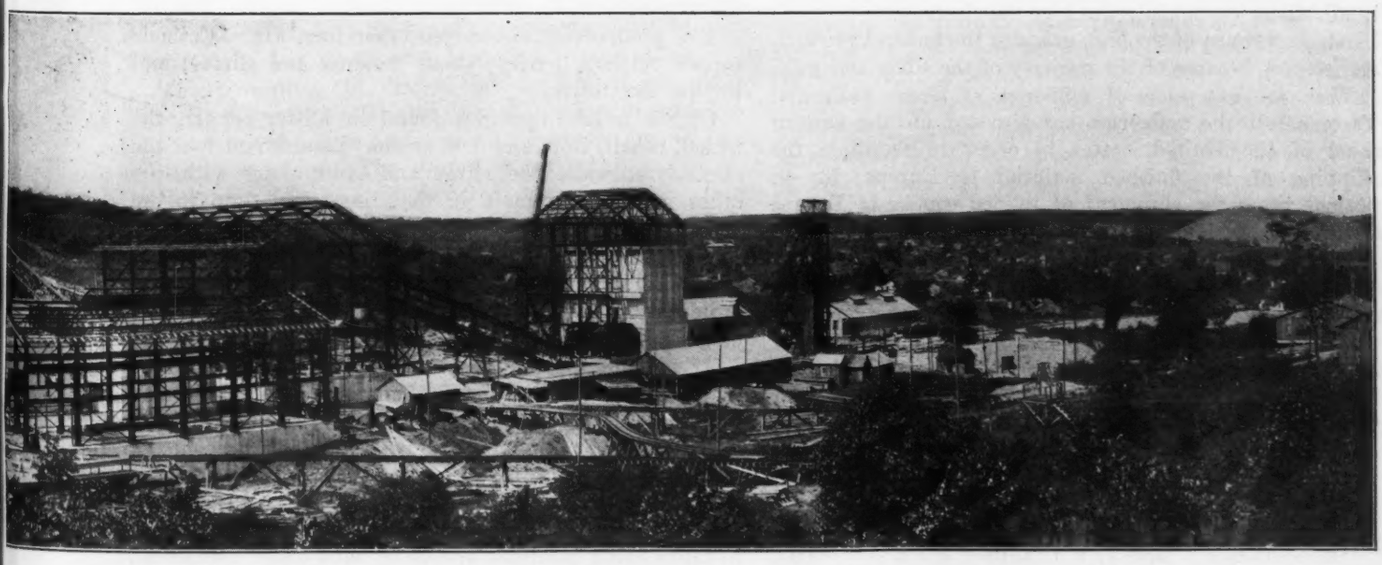


PANORAMIC VIEW OF THE CHRISTMAS MINE, PINAL COUNTY, ARIZONA



PROGRESS OF THE CONSTRUCTION OF THE 2,500-TON
The upper photograph shows the mill site on Mar. 13, the middle one the progress of





MILL OF THE FEDERAL LEAD CO., FLAT RIVER, MO.
the work on June 13, and the lower picture the accomplishment on Sept. 5, 1916

Electrolytic Copper Refining*

SYNOPSIS—The stages of electrolytic copper refining are the melting of blister copper and casting it into anodes; electrolytic refining to secure pure cathode copper; and melting the cathodes and casting into commercially appropriate form. The conducting of each stage is discussed, together with the appliances used.

With the exception of the large body of native copper in the northern peninsula of Michigan, the commercial ores of copper are sulphide ores, widely disseminated through the entire world. In the western part of the United States, notably Montana, Arizona and Utah, are enormous deposits which furnish 40% of the total production of copper. Large deposits are also found in Alaska, Mexico, South America, Africa, Japan and Russia, while the copper deposits of Spain have been utilized for centuries, not only for their copper contents, but also for their sulphur value.

For economic reasons, chiefly on account of the low copper contents of the ores which will not permit of freighting, the smelteries are erected near the mines where the ores undergo a series of metallurgical processes such as concentrating, roasting, smelting and converting, the final product being an impure copper technically known as "blister copper." This is not suitable for commercial purposes and must be refined, which may be accomplished by oxidation and subsequent reduction in reverberatory furnaces, depending upon the scorification effect of copper oxide to eliminate the impurities.

The Electrolytic Process

The electrical industry, which is utilizing the major part of the output of copper, however, requires an exceedingly pure grade which the fire-refining process cannot supply; moreover, most of the copper ores carry traces of silver and gold, which concentrate in the blister copper and which are not recovered by fire refining.

It is for these reasons that at the present time practically all blister copper is refined by the electrolytic method: First, on account of the high grade of the finished product, and second, because of the recovery of the silver and gold.

With the exception of refineries at Great Falls and Tacoma, all the refineries are situated on the eastern coast of the United States in order to facilitate the shipping of the finished material to Europe, for in normal times the shipment of refined copper to Europe far exceeds that of home consumption.

Electrolytic refining may be divided into three stages: Melting the blister copper and casting into anodes ready for the electrolytic tanks; electrolytic refining and obtaining cathode copper of 99.98% purity; melting of cathodes and casting the commercial shapes, such as wirebars for wire mills, cakes for rolling mills, ingots for the brass and alloy manufacturers, etc.

The blister copper is delivered to the refinery in the form of slabs weighing about 300 lb. These are melted in reverberatory furnaces known as blister furnaces, of 300,000 to 500,000 lb. capacity, the details of the operation being practically the same as in the refining furnaces, which will be described later. In this melting process but little refining is attempted, although some of the impurities are removed with the slag and the sulphur is practically eliminated. The copper is cast into anodes 37x28x1⅝ in., weighing about 500 lb. A typical assay of anodes is as follows:

TYPICAL ASSAY OF ANODE COPPER

Copper	99.25%	Antimony	0.052%
Silver	70.0 oz. per ton	Nickel	0.050%
Gold	0.25 oz. per ton	Lead	0.053%
Arsenic	0.060%	Iron	0.058%
Bismuth	0.003%	Tellurium	0.038%
Sulphur	0.004%	Oxygen	0.100%
Selenium	0.008%		

More complete analysis would disclose traces of many other elements.

The theory of electrolytic refining is simple. If in an electrolyte of suitable composition are placed two copper sheets connected to the terminal of a generator, the sheet connected with the negative pole being known as the cathode, the other connected with the positive pole being known as the anode, on passing a direct current of suitable voltage and density, the current will enter the anode, pass through the solution to the cathode, dissolving copper from the anode and depositing an equivalent quantity of copper upon the cathode. Owing to the energy generated at the anode, by the solution of the copper the total intensity factor, the voltage, is small, usually about 0.25 volt per tank. The capacity factor, the amperage, follows strictly Faraday's law, copper acting as a divalent metal. One ampere per hour deposits 1.186 grams of copper.

In practice a number of tanks are connected in series, the electrodes in the individual tanks being in multiple. The electrolyte is an acid solution of copper sulphate, usually 16% bluestone with 12% of free sulphuric acid. The current dissolves the impure copper from the anodes and deposits pure copper upon the cathodes, the impurities either dissolving and fouling the electrolyte or not dissolving and dropping to the bottom of the tanks, known as "slimes."

The products of electrolysis, therefore, are: Cathode copper, 99.98% purity; anode residues and slimes; and impure electrolyte.

Of the usual impurities found in blister copper, the nickel, cobalt, iron, zinc and arsenic dissolve and foul the electrolyte, while the silver and gold along with the other impurities remain in the slimes and drop to the bottom of the tanks.

Since the purity of the cathode copper depends on the purity of the electrolyte and impurities are constantly building up, it is necessary for all refineries to purify daily a certain volume or percentage of their electrolyte.

At some of the refineries the electrolyte is purified by a series of crystallizations, whereby the copper in the electrolyte is recovered as commercial blue vitriol and sold as such. The nickel is recovered either as nickel sulphate (single salts) or as metallic nickel, and the acid after removal of the arsenic is used over again in the electrolyte. At others the electrolyte is electrolyzed in tanks using insoluble anodes of hard lead "liberators" until practically all the copper has been deposited. The

*Excerpts from a paper by F. L. Antisell and S. Skowronski, presented at the annual meeting of the American Institute of Metals, September, 1916.

nickel sulphate is then crystallized, and the acid is used again in the electrolyte.

The slimes are periodically pumped from the electrolytic tanks to the silver department, where, after an extended series of metallurgical processes, the silver and gold are recovered in a pure condition. The semi-rare metals, selenium and tellurium, are also recovered, but the commercial demand for these is so small that only a fraction of the possible recovery is attempted. Small quantities of valuable platinum and palladium, which are recovered, concentrate in the slimes. The lead, bismuth and antimony are generally shipped either as crude metal or as flue dust to lead smelters for further purification.

The cathode copper containing 99.98% copper should be an easy melting proposition, but copper when molten absorbs gases to such an extent that the melting process becomes a refining process, refining from the gases absorbed during the period of melting. Copper when molten absorbs hydrogen, carbon monoxide and sulphur. Our methods of chemical analysis have not yet reached the refinement of determining hydrogen and carbon monoxide, both of which if present in copper must be there in very minute quantities. Sulphur, however, can easily be determined, and the effect of sulphur on copper has been carefully studied. The presence of oxygen, or copper suboxide, greatly increases the solubility of the above gases in copper, and it is for this reason that from 0.30 to 0.80% of copper suboxide will always be found in commercial copper.

The Technology of Refined Copper

Copper is said to be "tough pitch" when it has set with a level surface. "Underpoled" copper is that which has set with a concave surface, due to too high oxygen contents, and "overpoled" copper is that in which the oxygen content is so low that the solubility of the gases in the copper has decreased until the surface set shows a distinct convex crown, and sometime a worm-like projection called spewing. Overpoled copper has always been considered as copper with too low oxygen content, but it is possible to melt cathode copper of 99.99% purity in crucibles so as to prevent the absorption of gases and obtain a perfect "tough-pitch" bar of 99.99% purity containing neither sulphur or oxygen. Overpoled copper should therefore be considered as copper too low in oxygen for the amount of gases dissolved in the metal.

The percentage of oxygen in tough-pitch copper is directly dependent upon the amount of gases dissolved in the copper, and it is impossible to overpole copper free from these gases. The copper is melted in large reverberatory furnaces of 200-250 tons capacity. The furnaces in normal times are usually lined with magnesite bricks up to and above the metal line, with silica-brick roof and sides. Chrome bricks have been tried with success. The bottom of the furnace is usually of high-grade silica sand, although silica bricks have been tried on the smaller furnaces with success.

The usual fuel is bituminous coal low in sulphur, and to a limited extent powdered coal, fuel oil and gas. Direct coal fire is the usual type, carying a bed of fire 4 to 5 ft. deep. The melting or refining operation may be divided into charging, melting, oxidizing, deoxidizing (poling) and casting. All operations are so conducted that it takes about 24 hr. to carry through to completion the full cycle of operations.

Charging was formerly done by hand, but now all furnaces are provided with charging machines. The machine picks up 40 cathode sheets, weighing about 5,000 lb., at a time and puts them in the furnace much more compactly than could be done by hand, thus materially increasing the capacity of the furnace. The time of charging is usually 2 hr. After the furnace is charged, the side doors are closed and luted, and fire increased to hasten the fusion of the copper. In about 10 to 12 hr. enough copper is melted so that the oxidation period can begin. In this period the molten copper is nearly saturated with cuprous oxide and brought to what is known as "set copper," containing from 4 to 5% of suboxide. In this process all impurities are oxidized and all hydrogen, carbon monoxide and sulphur compounds removed. This is accomplished by blowing compressed air through iron pipes under the molten bath, also by "flapping" the charge. Flapping consists in striking the surface of the metal with the edge of the head of a rabble, in order to uncover the surface of the copper. The furnaceman watches the operation by taking button samples and observing the fracture, the fracture in all stages being characteristic and well defined. Tests during this period show that after melting, the sulphur content of the charge is from 0.0030 to 0.0050%, which is gradually driven off by the copper suboxide formed until at set copper the metal is free from sulphur. The sulphur comes from the fuel and the sulphuric acid left on the cathodes. During the oxidation period a strong basic oxide slag is formed, containing about 50% copper. This is melted in a blast furnace to blister copper.

After the charge is oxidized, the slag formed is skimmed off, the bath covered with coke or charcoal and the poling process begins. This consists in forcing the butt ends of green poles underneath the surface of the metal and causes a violent action in the metal bath, the carbon from the wood and coke reducing the dissolved cuprous oxide. The operations takes from 3 to 5 hr. When the suboxide of copper has been reduced to 0.3 to 0.6%, which can be readily told by the fracture of the button sample, the copper has reached the tough-pitch stage and is ready for casting. On a 250-ton furnace, 25 and sometimes 40 large poles will be used before the copper shows the proper pitch. During the poling the copper again picks up sulphur from the gases of the fuel and the coke used to cover the charge. The sulphur contents varying from 0.0010 to 0.0030% after poling.

The casting operation consists in forming the molten copper into commercial shapes, wirebars, slabs, wedge bars, cakes, ingots and ingot bars. The molds are made of copper and sprayed with bone-ash emulsion. The molds are placed radially on a circular casting machine—Clark casting machine or tangentially as in the Walker wheel. As the wheel turns around, the molds are filled from the furnace. After the copper has set, the molds automatically tip, dropping the copper bars into a water bosh, which pickles the copper and gives it the characteristic red color. The bars come up from the bosh on an endless belt, and after weighing, are ready for shipment. A representative analysis of refined electrolytic copper would be somewhat as follows:

ANALYSIS OF REFINED ELECTROLYTIC COPPER

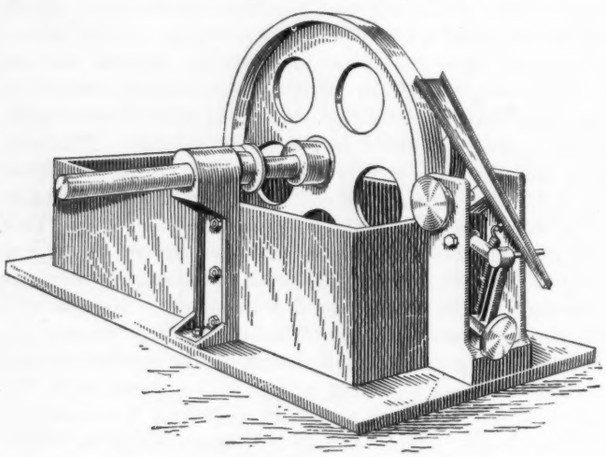
	%		%		%
Copper	99.93000	Oxygen	0.04500	Nickel	0.00150
Silver	0.00100	Sulphur	0.00300	Arsenic	0.00150
Gold	0.00001	Iron	0.00350	Antimony	0.00150

It takes from 5 to 8 hr. to take out a charge, and during that time the refiner has to keep the copper at the proper pitch and set, which can be easily accomplished provided the oxidizing and poling have been properly done, but if the oxidation period has not been carried nearly to "set copper," after about two hours of casting the copper will become "unhealthy," show signs of overpoling, and the furnace will be difficult to control.

In conclusion, the tendency in copper melting has been to encourage large furnaces. Only twelve years ago a 100-ton furnace was considered a large one. Today the 100-ton furnace in refineries is almost obsolete—200-250-ton units having taken its place.

Flotation Oil Disk Feeder

A mechanical disk feeder for flotation cells has recently been placed on the market by the Braun Corporation, of Los Angeles, Calif. As shown by the accompanying illustration, it consists of a heavy disk rotating within a tank



BRAUN DISK FEEDER FOR FLOTATION OILS

containing the oil or other reagent to be fed to the pulp. The rotating disk carries up a thin film of the reagent, which is scooped from the disk to any desired degree by the trough intercepting the smooth disk surface on its downward rotation side. Feed adjustment is regulated by the adjustment of the trough by micrometer screws. Grit or sludge entering the oil tank cannot disturb the regularity of feed by either choking the tank or reaching the disk surface. Two types of feeder are manufactured, one for feeding the oil and one for acid. The machine measures 30x20x15 in. and weighs 90 lb. net.

Lead Sulphide Roasting Reactions

W. Rrinders, in *Zeit anorg. Chem.*, 1915, XCIII, 213-31, and *Chem. Zeit*, 1916, XL, Rep. 196, through *Journ. Soc. Chem. Ind.*, Aug. 15, 1916, says that the roasting process consists of first incompletely roasting lead sulphide and then heating the product with further amounts of sulphide without admission of air, but with removal of the sulphur dioxide formed, until all the sulphur has been removed and the lead has separated. In this process the lead sulphate first formed does not react with sulphide to produce lead and sulphur dioxide directly nor are these products obtained by the interaction of lead sulphide and lead monoxide, but there are formed in succession the basic sulphates, $(PbO)PbSO_4$, $(PbO)_2PbSO_4$, $(PbO)_3PbSO_4$, and finally, PbO. Lead sulphide and lead monoxide are not stable together, but give lead and basic sulphate. Lead reacts with normal lead sulphate with the formation of sulphide, but this reaction does not take place with basic sulphates. The pairs of phases $PbS + PbSO_4$, $PbS + (PbO)PbSO_4$, and $Pb + (PbO)PbSO_4$ are stable and give monovariant equilibria when heated in closed tubes; only when the sulphur dioxide is withdrawn does the separation of the lead proceed. Pressure and temperature measurements have given, for the complete reaction, the equation $PbS + PbSO_4 = 2Pb + 2SO_2 - 99{,}543$ cal. The value calculated from the heats of formation is 95,230 cal. The separated lead retains a certain amount of lead sulphide in solid solution.

The Use of Gins and Shears

The gin pole is familar enough around the surface operations of a mine, but the three-legged gin is not as commonly used as it would be if its convenience and advantages were more generally realized. The gin, which requires no guys, is really a tripod formed of three poles; the two outside ones are called legs, and the third one the pry pole. It is used for lifting weights vertically and can safely be used for loads up to 17,000 lb. When made for permanent equipment, a windlass operated by hand spikes or crank is used between the two legs, and a block and tackle is hung from the pin and clevis through the top, the fall of which goes around the windlass. Two braces are used between the two legs, one above the windlass and one below.

In assembling the gin (Fig. 3) the legs and pry pole are laid on the ground with the heads together, the legs

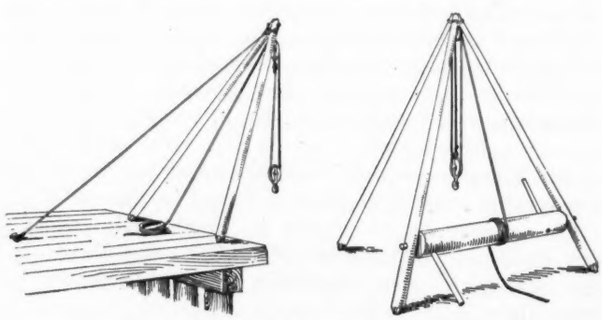


FIG. 1. SHEARS, AND FIG. 3. GIN

in one direction and the pry pole in the other. The head is assembled by putting the pin through the pry pole, clevis, and legs. The gin is raised, after being put together, by lifting the heads and bringing up the foot of the pry pole toward the feet of the other two legs.

There are many times when a tripod with a block and tackle could be employed to great advantage, without the necessity of using a windlass, and for this purpose a tripod can be made with a lashing at the top which, for temporary work, will answer every purpose of the pin and clevis of a permanent gin. To make this lashing, as shown in Fig. 2, lay the three legs on the ground with their heads together as described; mark on each

spar the distance, equal for all legs, from the butt to the center of the space to be occupied by the lashing. Lay the three spars on the ground parallel to one another with the head of the pry pole between the heads of the two legs, as described, leaving an interval of about 2 in. between the poles. Rest the heads of the three poles on a skid to give convenience in passing the lashing underneath the poles. Make a clove hitch (*A* in Fig. 2) on one of the outer spars below the lashing and take eight or nine loose turns around the three spars, as shown. Then take a couple of frapping turns (*B* in Fig. 2) between each pair of spars in succession and finish with a clove hitch on the central spar above the lashing, as shown. Pass a sling over this lashing, into the two bights of which the block is to be hooked, and the tripod is ready for raising in the manner previously described.

By means of this simple lashing it is possible, in a few minutes with only some rope, a block and tackle is attached to the guy strap. The other end of the guy strap is adjusted in the same manner, the strain on each guy thus tending to bind the spars together (see Fig. 2).

The main tackle sling is then put on over the cross, passing over the guy straps. The upper block of the main tackle is then hooked through both bights of the main sling and the hook moused.

If the shears are not too heavy, they are raised by lifting the head and hauling in on the proper guy ropes. If too heavy to raise in this way, a crutch is formed by lashing together two small poles near their upper ends, the feet of the crutch being slightly in the rear of the heels of the shears and secured to prevent them from slipping. The guy ropes of the shears are led over the crutch, and the crutch itself is raised by two light guy ropes until it is inclined to the front at an angle of about 45°. Then by hauling on the rear shear guy, allowing

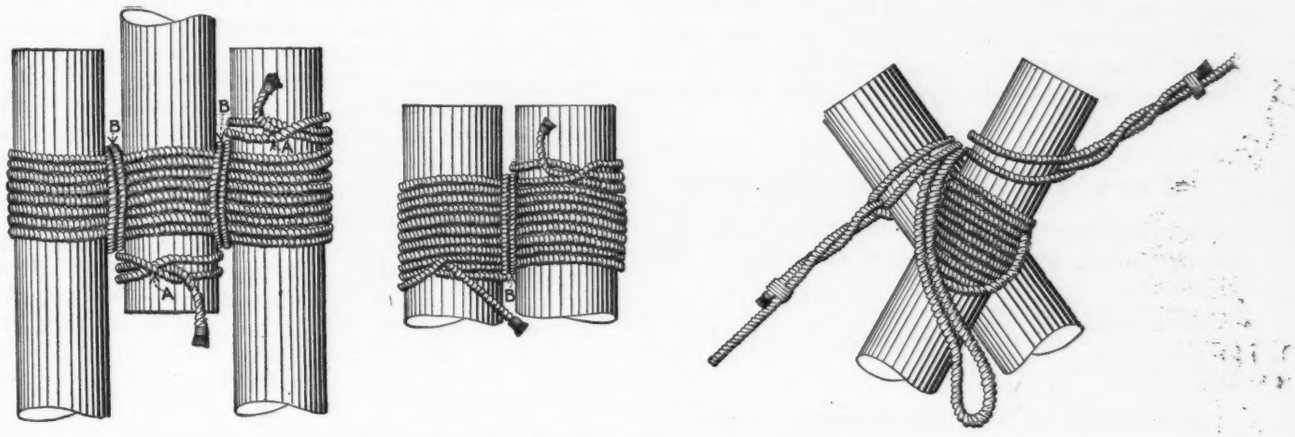


FIG. 2. DETAILS OF ROPE FASTENING ON GIN AND SHEARS

and three poles, to make a very stiff, serviceable device which will lift 8½ tons. This amount of rude equipment is more often at hand than any regular lifting device of the capacity given.

The Use of Shears for Lifting Weights at an Angle

Shears, Fig. 1, consists of two spars of a suitable size for the weight to be raised, lashed together at the cross, with the feet spread apart. They are supported in an inclined position by means of guys. They are used for lifting heavy weights where the lift is at an angle; that is, not vertical. They are rigged as follows:

The two spars for the shears are laid alongside of each other with their butts on the ground, with points below where the lashing is to be resting on a skid. A clove hitch is made around one spar, and the lashing (see Fig. 2) taken loosely eight or nine times about the two spars above the hitch without riding. A couple of frapping turns are then taken between the spars (see *B*, Fig. 2), and the lashing is finished off with a clove hitch above the turn on one of the spars. The butts of the spars are then opened out, and a sling, or guy strap, having the splice in the center, so that it cannot come into either bight, is then laid between the spars above the cross and equally divided. Each bight is led around the spar farthest away from the guy for which it is intended, the bight brought back around both spars for the upper guy block to be hooked to, or the guy rope itself the crutch to rise as the shears rise, the latter can be raised until the crutch reaches a vertical position and ceases to act, after which the shears can be raised to position by continued hauling on the guys. Made of the proper size of material, such as can be obtained ordinarily, shears will handle weights up to 25 or 30 tons.

Both gins and shears ought to be used more about mine and mill construction where now the work waits either for a contractor's derrick or the final crane to be put in place. Their use would obviate many awkward makeshifts which are too often resorted to by force of necessity.

Report of Wallaroo and Moonta Operations

The report of the directors of the Wallaroo and Moonta Mining & Smelting Co. for the first half of 1916 has been issued and contains the following data relative to the production and activities during the period.

From the Wallaroo mines 28,886 tons of ore averaging 8.79% copper has been removed while 4,302 tons, averaging 14.81% copper has been taken from the Moonta mines. In addition 524 tons of concentrates from the latter averaged 71.85% copper. At the smelting works the copper recovered from the treatment of these ores and concentrates plus an additional 1,185.75 tons realized from the treatment of purchased ores, matte and blister

copper made a total copper production of 4,447 tons and indicated a metallurgical recovery of 94%. In addition to this copper production the sulphuric acid plant, which was in operations 159 days during the period, produced 3,250 tons of sulphuric acid. To accomplish this production 1,141 men were employed at the Wallaroo mines, 536 at the Moonta mines and 335 at the smelting works making a total of 2,012.

At the Wallaroo mines both the Taylor and Young shafts were sunk to depths of 2,966 and 2,575 ft. respectively. A total of 2,230 ft. of development work was done, showing up average grade ore. A total of 80,074 tons of ore was produced and a recovery of 95.06% was realized. At the Moonta mines more than the usual amount of development work was done with generally satisfactory showings. At the smelting works no additions have been made but in the electrolytic refinery additional capacity has been provided. Arrangements were made to provide for the manufacture of shells and upon the receipt of the first consignment of steel, Nov. 9th last, work started. Due to failure in receiving continuous shipments of steel the manufacture was interruped and finally discontinued.

Foreign Trade in Copper

Exports of copper from the United States in September are reported by the Department of Commerce as below, in pounds:

Ore and concentrates, contents	947,842
Unrefined, in bars, pigs, etc.	457,308
Refined copper in ingots, bars, etc.	65,267,928
Old and scrap	242,470
Plates and sheets	2,406,227
Wire	1,583,542
Total copper	70,905,317

The weight of ore exported in September was 15,884 tons; of concentrates 518 tons.

Imports of copper into the United States in September are reported by the Department of Commerce, as below in pounds:

Ore and concentrates, contents	15,010,209
Matte, contents	510,802
Unrefined, etc., in bars, pigs, etc.	20,119,481
Old, etc., for remanufacture	873,252
Composition metal, copper chief value	54,701
Total copper	36,568,445

Actual tonnage of copper bearing material imported in September was 43,676 tons ore, 11,766 tons concentrates and 444 tons matte.

Self-Luminous Paint

F. H. Glew, *Optical Soc.*, June 8, 1916, and *Chemist and Druggist*, 1916, LXXXVIII, 653, reports that when radium is mixed with zinc sulphide, it exerts a continuous excitation on the sulphide and eventually exhausts it. The British Admiralty specification for radium luminous paint is 0.4 mg. of radium bromide per gram of zinc sulphide; the paint is also made with half that proportion of radium. At the end of a year it is probable that paint made to the Admiraly specification will have only half its original luminosity. The more radium the paint contains the shorter will be the life of the zinc sulphide.

The act of mixing the paint exhausts the zinc sulphide somewhat, and it requires time for the radium to excite it to further action. A palette knife must not be used for mixing the paint or the crystalline structure of the zinc sulphide will be destroyed, with a corresponding loss of illuminating power. Other substances than radium are used in paint, mesothorium more frequently. Ionium would be an ideal substance, but it is not obtainable in a pure state.

Lignum-Vitae for Tunnel Sets

At a large gold-placer property it was found advisable to shorten a proposed ditch, or canal, by driving five tunnels at advantageous points. The greater part of the work being in tough andesite, roof support was necessary only at and near the approaches. Trees of almost infinite variety of strength and durability were available, as the ditch line traversed a jungle in the western foothills of the Andes, a few miles north of the equator. While for flume boards a certain tree called *tangarí* (resembling cedar, but yielding a sap similar to that of the "cow-tree" described by Baron Humboldt) furnished a wood that was extremely durable when kept wet, the conditions demanded a wood that was strong wet or dry.

Shorter tunnels of earlier construction, as well as exploratory drifts in the gravel banks, had been timbered principally with *tangarí;* some props requiring replacement at intervals. Examination of some husky old legs showed that all the best-preserved timbers were lignum-vitæ, known locally as *guayacan* (order of *Zygophyllaceae*). While eight varieties of this tree are known, only two grow to considerable size. The *guayacan doble* (sometimes designated as *guayacan roble*) furnishes the toughest wood, the fibers being interlaced in a peculiar manner; but the plain *guayacan* was found as large as 5-ft. diameter at the base. Felling and topping was accomplished with Collins round-helved axes, the trunks being cut to suitable lengths with two-man crosscut saws. This work and the splitting of the logs were performed by Ecuadorian negroes. The shaping of the caps and legs was done by Jamaica-negro carpenters, directed by Irish-American hard-rock specialists. Unskilled labor for lifting and carrying was mainly *mestizo* and pure *Quichua* stock, The work was expensive, but much of the timber will be good for centuries.

In the course of the work a curious superstition was confirmed. Several of the negroes objected to cutting trees during a period when the moon was full, on the ground that the timber would be less durable. The trees were cut, but the timber was finally rejected. It was found that the sap fermented, making the sticks slimy, disagreeable to handle and less desirable than those cut in accordance with the old African custom.

Smelters Refuse Ore Shipments from the smaller shippers, is the complaint throughout the Arizona mining districts. The Arizona State Bureau of Mines reports congestion of ore at all the smelting plants at this time, adding that many of the small operators whose properties are under development claim the smelters have not refused to handle the increased tonnage of the larger mines. The small operator's development, depends upon sale of ore, and when markets are closed to him, he is severely handicapped. To make a prospect pay for its own development is a method that should be encouraged and not retarded. It is easy to understand the good relations between the big producer and the smelter, but the growth of the mining industry depends upon the coming in of new producers. To encourage the small ore shippers is to make possible the opening of new mines Naturally the smelters prefer large and regular shipments, since to handle the small shipment requires as much clerical work, computation, etc., as does a large shipment.

Editorials

After the War

As the war draws on, more and more things become clear. In the early days we heard much respecting the stupendous cost of it. That does not appear to have been so serious a check as it was thought it would be. Certainly, the thing has been protracted long after the time set by some economists and none of the nations is even wavering.

The cost of the war is not truly measured in dollars. The real measure is the use of material and men. Suppose for example, that Germany had ample resources of all necessary material, so long as she had the men to produce what was needed and maintain the requisite number on the front, she could keep on fighting indefinitely. She might cease to accumulate any wealth, but she might avoid going backward. Germany is not in that position, but the manner in which she has been doing things illustrates the point.

The actual cost of the war is the waste of life, the waste of material and the wealth that has to be sacrificed to get material from abroad. In this view Sir George Paish was manifestly correct. We are beginning to see the converse in the United States, where we are accumulating an enormous hoard of useless gold, but have not enough of metals, of foodstuffs, of clothing material to satisfy our own people.

This is taking the national view of things rather than the individualistic. Germany has long taken a national view. Great Britain, France and Russia did not. They are doing so now, and they will continue to do so after the war. That is one of the things that is sure. The manner in which Great Britain has organized and nationalized her industries is one of the remarkable things of the war.

Great Britain figures that she can continue this war for four years more before the cost will bear the same relation to national income that it did at the close of the Napoleonic wars; but regardless of how that may be, it is certain that even if the war should terminate now, all the countries of Europe would be under great economic strain in paying the interest on their foreign debts. Waste in living is just as disastrous economically to a country as is waste in war. The individual who squanders food is economically just as much a criminal as he who sets fire to a building. Recognition of this in Germany has caused the government to assume control of the mode of living by the people. France and England have done so to a less extent. But after the war we shall hear more of such policies. The cry will be economy. The waster will be a criminal, who will be punished. We may expect to see laws limiting the use of automobiles, limiting the theater, checking not only things that are wastes, but also those that are nonproductive. Europe is going to produce all she can and is going to sell to America all she can. America must buy. She cannot continue to sell without buying. If she can buy things cheaply, that will not be to her disadvantage; rather will it be to her advantage.

The fundamental idea is that after the war Europe will be on a basis of organized national economy. America will be on a basis of individualism, license and extravagance. The political dissensions of the last few years in the United States have not been over questions of national welfare—at least not in so far as domestic policy is concerned—but have been between classes and as to which should be favored. All ideas of efficiency in industry have been at a discount on the theory that they savored of Wall Street. National expenditures on pork-barrel legislation have mounted high. Private expenditures have mounted higher. The laboring classes have aimed to work less and to produce less. Waste has been rampant. It is but to state an economic platitude that coal, flour, sugar, cotton, paper and all commodities would not be so high today if the American people did not waste so much of them.

In brief, unorganized America is going to be confronted by organized Europe after the war. The war is, moreover, teaching us the lesson that organization of production and consumption does not mean cartels, combinations and trusts arbitrarily to raise prices in the interest of some people at the expense of others, but rather does it mean national control for the sake of economy and efficiency in the interest of everybody.

The Demand for a British Department of Mines

The chief technical societies in Great Britain that have to do with mining and metallurgy—the Iron and Steel Institute, the Institute of Metals, the Institution of Mining Engineers and the Institution of Mining and Metallurgy—have united in a petition to the government for the creation of a department of minerals and metals. The duties contemplated for such a department are as follows:

1. Arrangements for expediting the completion of mineral surveys of the United Kingdom and of the Crown Colonies and other British possessions.

2. The systematic collection and coördination of information bearing on the occurrence, uses and economic value of minerals and their products, special attention being devoted to securing industrial applications for newly discovered minerals or metallurgical products and to finding mineral materials required for new metallurgical products or inventions. Some of this information should be promptly and widely disseminated in summarized form to those interested in the industries, through the medium of the existing publications of the institutions directly concerned.

3. The investigation of all questions and problems relating to the utilization of the mineral or metallurgical resources of the Empire.

4. The coördination and dissemination of information on mining laws, development of mineral areas, output, processes of extraction, plant, capital employed, markets, etc.

5. A general review from time to time of the developed and undeveloped mineral resources and of the position of each mineral or metal, to insure that the mineral wealth of the Empire is being exploited with due regard to imperial interests.

6. Generally, to advise the Imperial Government on all questions bearing on the mining and metallurgical industries. To perform this function efficiently, it is essential that complete information should be available, and also that the in-

dustries concerned should be consulted through their respective organizations.

This movement is praiseworthy, but not very much confidence is ever to be placed upon a bureaucratic institution, conducted under governmental auspices. Look at the United States, where the most marvelous development of the world in mining and metallurgy has occurred wholly on private initiative.

We recommend to the mining and metallurgical institutions of Great Britain a concerted propaganda for the development of interchange of information among the miners and smelters of the United Kingdom. The ancient habits of secrecy, upon which we have previously commented, have been one of the great blights upon British mining and metallurgical progress. Observe, for example, the admirable transactions of the Institution of Mining and Metallurgy—an organization that has acquired the highest standing, not only nationally but also internationally. The major parts of its publication are of colonial and foreign origin. Seldom is anything offered from Cornwall, Wales or the north of England.

Not long ago the *Journal* invited a British metallurgist of international reputation to contribute a memoir upon the metallurgical practice of his district. He replied that regretfully he could not, for although he had been working there as superintendent and manager for about 30 years, he had never been in any of the works of the district except his own. The great strides in American progress date from the time when we became emancipated from the old traditions of secrecy and began freely to interchange information by conferences and visits and by contributions to the technical press and the proceedings of the professional societies.

Refined Spelter

It would be interesting if we could have statistics of the world's production and consumption of high-grade and other special classes of zinc during the war. Some time in the future we may be able to review that phase of the situation in a comprehensive way. At present we do not have statistics of the world's production of zinc, anyhow—only the outputs of some of the producing countries. That the demand for the superior zincs has been very large is of course well known, and the production has been correspondingly large. The New Jersey Zinc Co. and the American Zinc, Lead and Smelting Co. produce high-grade zinc directly from ore by virtue of the purity of the Franklin and Mascot ores respectively, although of course proper care in smelting and handling it is taken. There has been a small production of electrolytic spelter of high grade directly from ore, and that is now becoming large. Many other smelters have produced high-grade spelter by refining common by redistillation, either in ordinary ore furnaces, in special furnaces or in electric furnaces. These refiners have handled either their own product of common or have bought the latter in the open market, often with considerable influence on the latter. Brass special spelter, so called, is produced simply by selecting the best drawings of common spelter.

The development of the business of zinc refining could have but one natural result; namely, the contraction of the price differential between high-grade and common to a figure corresponding to the cost of refining. This has reference, manifestly, to high-grade broadly speaking. If a buyer insists on some special brand, the makers thereof may of course ask and get for it what they please, but in general they also are constrained to meet the market. Ever since the tension in zinc reached its climax, such a contracting tendency has been in evidence. The maxima were about 25c. for common spelter and 40c. for high-grade. No minute deductions ought perhaps to be drawn from those figures, for there was never a broad market for common spelter at the 25c. level, while at about that time high-grade and high-grade intermediate were held variously at 30 to 40c. per lb. It would probably be safe, however, to say that the real price differential at that time was 10c. per lb., and later it doubtless was higher, the prices for high grades being maintained for a long time after that for common had declined. But the natural law asserted itself gradually.

Of late there has been but little difference between the prices for common spelter and brass special. With the former at 10⅛c., the latter was about 10½c. This difference is not greatly in excess of what frequently prevailed in normal times, ⅛ to ¼c. per lb. being not uncommon. At the same time high-grade metal—99.9% Zn—sold at 14½@15c. per lb., a premium of but about 4¾c. over common. In former times the premium for special brands of high-grade, which then used to be produced in relatively small quantity, was about 2½c.

Without any doubt the price differential will eventually contract to the cost of refining, including an allowance for amortization of plant and plus a reasonable profit, which will be established by competition. The actual cost of redistilling zinc may be as low as ½c. per lb., and the loss of spelter may be as low as ½%, which would be ½c. per lb. on 10c. spelter. In ordinary practice, however, these figures are probably more nearly 1c. and 10% respectively.

British Copper Purchases

The large purchases of copper by the British government have been made on the basis of a price f.o.b., New York. Private buyers in Great Britain still insist, however, in buying on the old terms of c.i.f., England. This puts them at a disadvantage, for freight rates, war risks, etc., are so uncertain that an American seller can make c.i.f. terms only with such a margin in his favor as will amply protect him against vicissitudes. It would be better if British private buyers should purchase on basis of f.o.b., New York, and themselves assume the transportation and insurance charges. Of course there is now no private buying from Great Britain unless somebody has a chance to get supplies at less than the price at which the British government offers them.

The Boom in Copper Stocks

During the week previous to election there began something very like a boom in the copper stocks, which was apparently based upon a belated realization that these producers have been making a great deal of money, have been accumulating huge surpluses and have become, moreover, sure of a further large profit in 1917 by virtue of the sales that already have been booked. This led to a sort of riot in speculation. Once the fever is contracted, reason is lost. The conservative person who coolly figured that Utah might be worth intrinsically

95, let us say, is apt to lose his balance when it rises to 114, forgets what he used to think and begins to contemplate that it may go to 125.

Of course there has been talk about increased dividends, extraordinary Christmas extras, etc. That is all right within bounds, but there is enough uncertainty ahead to cause copper managements to be conservative, even if they have already sold at high prices a large part of their expected production in 1917. Nobody knows what is going to happen as the war draws toward a close. The wisest thing for every company is going to be to have a big surplus of cash when that time comes.

New Uses of Metals

During the last year there has been an increased demand for many of the rare elements and many of the metals for which heretofore there has been but little use. To what extent this has been due to military needs and to what extent it is attributable to advances in the peaceful arts will remain for the historian of the future to tell. The stimulus that has been given to chemical and metallurgical industries undoubtedly has led to many important discoveries by chance.

At present molybdenum is in great demand. The supply of molybdenite is temporarily insufficient. There have been new demands for cadmium and bismuth. Selenium is a commercial commodity, and thallium is being produced. Modern chemistry is showing the harmfulness of minute impurities for many purposes. On the other hand, it is showing the benefit of minute additions of foreign substances for other purposes. For example, there is now being produced in the United States electrolytic tin of extraordinary purity. For some purposes this is found to be far superior to anything else, but for some purposes it has proved to be too pure, a fault that can, of course be easily corrected.

The American Smelting and Refining Co. is going to retire the bonds—$15,000,000—of the American Smelters Securities Co., which are callable at 105, but also are convertible into common stock of the smelting company at par. The smelting company has called the bonds, which will mean that holders will convert them into stock, both the stock and bonds now selling at the same premium. The smelting company will thus relieve itself of bonded obligation, and another step toward the simplification of the relations between the smelting company and the securities company will have been taken. Inasmuch as the smelting company owns all of the common stock of the American Smelters Securities Co., the only issues of the latter in the hands of the public will be its preferred stocks A and B. The preferred B will become the premier issue of the whole smelting group, inasmuch as its dividends are guaranteed by the American Smelting and Refining Co.

The recent strike at a lower level in the Magma mine in Arizona is believed by the management to promise the conversion of that property from the proportions of a small mine to those of a big one. Like the United Verde Extension, the Magma is a lode mine of high-grade ore. These interesting developments of the last year or two in Arizona bear out what we have previously remarked; namely, that the day of new mining discoveries of the first order is not yet past.

BY THE WAY

The *Ax-I-Dent-Ax,* "safety first" publication of the United States Metals Refining Co., at East Chicago, Ind., notes some good work in loading metal. It says: "We believe that a record was made by E. W. Merrick's 'huskies' when the regular crew of four men loaded 300 tons of lead in six hours, which is our idea of efficiency. The members of this gang are: Frank Obratte, Mike Skifish, Nick Pesusich and Andy Ambrose."

The general manager of one of the large Arizona copper properties put in a year of his early apprenticeship as assayer at a mine down in the Republic of Honduras. Being more interested in his work than was compatible with indulgence in local terpsichorean entertainments, be gruffly declined an invitation to a *baile* with an offhand remark to the general effect that "dancing with lemon-tinted ladies offered no attractions." At the expiration of his contract he was informed that his attitude had not been such as to promote harmony with local officials, and that a renewal of employment was not convenient. This arrangement fitted in perfectly with the plans of the now famous engineer, who often chuckles as he recollects the farewell oration of the one individual, in all the camp, who had a kind word for him. This was an unclothed five-year old urchin who stood at a bend in the trail, gravely waving his tiny hand as he piped, *"Adios, quimico. Buen viaje, Don Benjamin."*

Mining in 2 in. of ground may sound unreasonable, but it is really true, according to a writer in the New York *Evening Post.* Did you ever stop to consider what becomes of all the lead fired from the shells of trapshooters' guns? Of course you know trapshooters have the same hunting grounds week in and week out. Therefore the constant shooting over practically the same territory makes lead mines, for whether the aim is good or bad, the lead finally falls to the ground. Far-sighted contractors have seen the business possibilities in "getting after" this mining business. At prominent clubs, where many squads shoot every week, it is only a matter of a few years when it is profitable for the mining business. About three years ago the ground in front of the traps at the du Pont Gun Club was "mined," and a pile of lead of 23 tons was the result. A portion of the grounds of a club at Columbus, Ohio, was put through the "sieve" and 26 tons resulted. A year ago a second trip was made to the du Pont Club at Wilmington, Del., and results equal to the first attempt were obtained. Other club grounds are now undergoing mining treatments. The methods of securing this lead are simple. Plots of ground about 3x5 ft. are skinned about 1½ in. deep. This topsoil is then put in piles and allowed to stand for two or three days until it dries. It is then put into a large, coarse cylinder sieve which gets rid of the earth containing no lead. Then it is put through a fine sieve and more dirt is removed. If the earth sticks, several screenings are necessary until only the lead remains. Then the remainder of the shooting territory is handled in the same manner. On grounds like the du Pont Club it takes about 60 lb. of earth to give off 1 lb. of shot.

Personals

Ralph Arnold is in New York.

H. K. McIntosh has gone from Goldroads, Ariz., to San Francisco.

A. L. Trent, lately at Isabella, Tenn., has gone to Drummondville, Quebec.

George A. Creswell has gone from Manhattan, Nev., to East Oakland, Calif.

H. G. Pickard, lately in Washington, has gone to Brantford, Ont., for the present.

W. de L. Benedict has returned to New York after an absence of six months in California.

Robert E. Cranston, of San Francisco, has gone to British Columbia on professional business.

Myron R. Walker, recently at the Cerro de Pasco in Peru, is now at Casa Grande, Ariz.

C. E. Musselman, recently with the American Zinc Co. at Mascot, Tenn., has gone to Allentown, Penn.

Grant D. Miller has returned from Cuba, where he visited some copper properties in western Cuba.

E. Gybbon Spilsbury has gone to Cuba on professional work and will be absent about three weeks.

H. P. Henderson returned to New York from Cuba, where he had been on professional business, on Nov. 8. Mrs. Henderson accompanied her husband.

Dr. J. Hunt Wilson, of Lehigh University, has become assistant professor of chemistry at Lafayette College.

Blamey Stevens, of the Lane-Rincon Mines, Inc., Temascultepec, Mexico, is making a short visit to the United States.

W. W. Adams has gone from San Antonio, Tex., to Minas de Palomas y Cabrillas, Higneras, Coahuila, Mexico.

Theodore J. Hoover has come over from London to enjoy a holiday of six months in this country. He will join his family in California.

George Aylard, of Victoria, president of the Utica Mines, Ltd., has been on a visit to the Utica in connection with the driving of the low crosscut tunnel on that property.

Dr. J. Ernest Carman, of the University of Cincinnati, has been appointed to the chair of geology at the Ohio State University, vacant by the death of Prof. Charles S. Prosser.

Dr. Eugene C. Bingham has resigned the professorship of chemistry at Richmond College to become professor of chemistry and director of the Gayley Laboratory at Lafayette College.

Heath Steele, of New York, has gone to Deadwood, S. D., on examination work. He will also go to Montana and Nevada on professional business, returning about the end of November.

M. St. Clair and son, of the St. Clair Mining Co., Duluth, Minn., who are heavily interested in the iron industry, were recently inspecting iron properties in the Fort William district, in Ontario.

Dr. George Otis Smith, director of the Geological Survey, will speak on "Geology and Public Service" at the December meeting of the Geological Society of America, which is to be held at Albany.

Dr. F. G. Cottrell, chief metallurgist of the Bureau of Mines, is in Butte, Mont., in conference with Dr. L. D. Ricketts. They are going over the recently drafted report of the Anaconda Smelter Board.

Dorsey A. Lyon has returned to Salt Lake City after a visit to New York and Washington. Mr. Lyon is in charge of the work being done by the Bureau of Mines in coöperation with the University of Utah.

Prof. William Nicol, who has been on the staff of Queen's School of Mining, Kingston, Ont., for over a quarter of a century, has resigned on account of ill-health and has gone to Los Angeles, Calif., for rest.

Norman Braley has been promoted from the position of superintendent of the North Butte Mining Co. to that of general manager. Lester Frink, who has been assistant superintendent, has been made superintendent.

C. E. Lesher, statistician of the Geological Survey, left Washington Nov. 1 for a month's trip to coal-producing centers. He is gathering information for the year-end review which is issued by the Geological Survey.

F. K. Brunton has resigned from the staff of the American Smelting and Refining Co. at Garfield, Utah, to accept a position as assistant superintendent of the Consolidated Arizona Smelting Co. at Humboldt, Ariz.

J. D. Sperr, formerly of Oatman, Ariz., but now engaged as consulting engineer in the Jerome district of Arizona, has returned to his home in Prescott after completing an examination near the Chino copper mine in New Mexico.

Sidney Paige, in charge of Western areal geology for the Geological Survey, has returned from a general investigation of faulting in the San Juan Mountains in Colorado, in the Yosemite Valley region of California and in southern California.

Dr. Edward Hart has retired as active head of the chemical department of Lafayette College, Easton, Penn., but remains connected with the department as professor of chemical engineering and as librarian of the Henry W. Oliver Chemical Library.

Charles E. Mills has been appointed president of Cananea Consolidated Copper Co., vice Dr. L. D. Ricketts, who will remain with the company in an advisory capacity. Mr. Mills will continue as general manager of the Inspiration Consolidated Copper Co.

Van. H. Manning, director of the Bureau of Mines, will leave Washington Nov. 12 for Chicago, where he will address the American Mining Congress. Before returning to Washington he will visit Kansas City and other points where the bureau is doing work.

Herbert W. Gepp, general manager of the Amalgamated Zinc Co. of Australia, who has been in the United States on business for his company during the last two years, will sail for Australia about the end of November. He expects to return to the United States next spring.

Norman L. Warford, until Nov. 1 in charge of the powdered coal department of the Anaconda Copper Mining Co., has now become identified with the Powdered Coal Engineering and Equipment Co., of Chicago, Ill., in the capacity of engineer in charge of construction.

Charles Kettleborough, of the Indiana Legislative Bureau and a member of the State Commission on Mines and Mining, was in Washington recently gathering information looking to a revision of the mining code of Indiana at the next session of the legislature in that state.

Obituary

Alexander McKinnon died at Iron River, Mich., Oct. 17, aged 74 years. He was one of the pioneers of the iron country and founder of the town of Iron River. He owned interests in several large mines.

Joseph Lumley, one of the oldest manufacturers of mining machinery in the United States, died Oct. 21 at his home in Philadelphia, following an illness of three months. He was born in Dublin, Ireland, and came to this country with his parents when he was five years old. Forty years ago he started the manufacture of engines, boilers and mining machinery at Third and Cherry St., Philadelphia. He installed some large mining plants in this country and in South America. He leaves his widow, a daughter and a son.

James C. Wallace died at Cleveland, Ohio, Oct. 31, aged 51 years. His name had been linked closely with Lake vessel building for more than 20 years, as that of his father, Robert Wallace, had been for a generation. After passing through the public schools of Cleveland, the younger Wallace entered the employ of the Globe Iron Works as a machinist. In 1887 he went into the drafting room of the Cleveland Shipbuilding Co., of which his father was general manager and later president, and at length was given full charge of the drafting department. Five years later he was advanced to vice-president and general manager. In 1899, when the Cleveland Shipbuilding Co. was absorbed by the American Shipbuilding Co., Mr. Wallace became general manager, and in 1904 was elected president. He retired in 1914, and had since devoted himself to his vessel interests.

Lieut. George Simpson, of Company C, Durham Light Infantry, was killed in action July 4, 1916. In the early part of the British advance in Picardy, Lieutenant Simpson earned the admiration of his men and the praise of his superior officers by his fearless bravery and efficient organization of stretcher parties at the front of the line. Left in command of the company by the wounding of his captain, he worked harder than ever; though without food or sleep for almost 36 hr. Within a few minutes of the time that his company was to be relieved the bullet of a German sniper passed through his head, causing instant death. Lieutenant Simpson was an occasional contributor to the "Journal" and an engineer of merit. His death is a loss to the profession as well as to the bereaved parents who, in mourning the loss of an only son, find consolation in the fact that their boy met a glorious and heroic end.

Societies

The Colorado Scientific Society, at its meeting Nov. 4, listened to Dr. William P. Headden, of the State Agricultural College, who presented his fourth paper on "Mineralogical Notes," and also a paper entitled "Some Analytical Notes on Titanium, Columbium, Tantalum and Zirconium."

American Mining Congress—The nineteenth annual meeting, as already announced, will be held at the Hotel La Salle, Chicago, Nov. 13-16. The provisional program shows that general sessions will be held each day. The Metalliferous Section, the Oil and Gas Section and the Coal Section will hold three sessions each; the Section on Uniform Mining Legislation five sessions. The Public Lands Section will also hold several meetings.

American Iron and Steel Institute—At the eleventh general meeting in St. Louis, Oct. 27, the chief point of interest was Judge Gary's presidential address, which was in the main an account of his impressions of China, Japan and the Philippines, obtained in his recent trip to the East. Technical papers were read as heretofore announced. At the banquet in the evening a handsome testimonial was presented to Judge Gary in recognition of his services to the Institute. The presentation was made by President Schwab, of the Bethlehem Steel Co., in a brief speech.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

Amalgamator. Rowe F. Lounsberry, Sheridan, Wyo., assignor to Mid-Continent Machinery Co., Sheridan, Wyo. (U. S. No. 1,202,398; Oct. 24, 1916.)

Classifier—Ore Classifier or Separator. Frank A. Goodale, You Bet, Calif. (U. S. No. 1,201,956; Oct. 17, 1916.)

Crushing—Apparatus for Disintegrating Ores and Other Materials. Arthur Feust, New York, N. Y. (U. S. No. 1,202,278; Oct. 24, 1916.)

Electric Furnace. Ignacy Moscicki, Lemberg, Austria-Hungary. (U. S. No. 1,201,607; Oct. 17, 1916.)

Electric Furnace. Ingenuin Hechenbleikner, Charlotte, N. C., assignor to Southern Electro-Chemical Co., New York, N. Y. (U. S. No. 1,202,-837; Oct. 31, 1916.)

Flotation—Concentration of Ores. Allen Crawford Howard, London, England, assignor to Minerals Separation American Syndicate (1913) Ltd., London, England. (U. S. No. 1,203,341; Oct. 31, 1916.)

Lead Sulphide—Process for the Manufacture of the Sulphate, Sulphite and Oxide Directly From the Sulphide of Lead. James Gitsham, London, England. (U. S. No. 1,201,955; Oct. 17, 1916.)

Potash—Process of Producing Potash. George F. von Kolnitz, Charleston, S. C. (U. S. No. 1,201,396; Oct. 17, 1916.)

Separator—Ore Separator. Albert M. Plumb, Denver, Colo. (U. S. No. 1,202,219; Oct. 24, 1916.)

Stamp Mill. Hector Gawley, Tacoma, Wash. (U. S. No. 1,201,717; Oct. 17, 1916.)

Tank—Acid-Proof and Electrolytic Tank. Rowland T. Wales, Sewaren, N. J. (U. S. No. 1,202,-457; Oct. 24, 1916.)

Zinc Oxide—Process for the production of Zinc Oxide. Edouard Hunebelle, Paris, France. (U. S. No. 1,201,586; Oct. 17, 1916.)

Assessments

Company	Delinq.	Sale	Amt.
Alpha, Nev.	Oct. 25	Nov. 15	$0.03
Big Cottonwood, Utah	Nov. 6	Nov. 24	0.01
Blue Bull, Nev.	Oct. 16	Nov. 20	0.01
Blue Star, Ida.	Sept. 25	Nov. 21	0.02
Buffalo, Ida.	Nov. 15	Dec. 12	0.005
Cedar Creek, Ida.	Oct. 23	Nov. 23	0.01
Columbus-Rexall, Utah	Oct. 27	Nov. 17	0.02
Comet, Ida.	Oct. 20	Nov. 20	0.00075
Confidence Silver, Nev.	Nov. 8	Nov. 29	0.10
Cornet, Ida.	Oct. 20	Nov. 20	0.00075
Consolidated Imperial, Nev.	Oct. 25	Nov. 15	0.01
Diam. Blk., Butte, Nev.	Oct. 12	Nov. 18	0.01
Diamondfield Blk B'tte, Nev.	Oct. 12	Nov. 18	0.01
Duluth, Ida.	Oct. 18	Nov. 18	0.001
Emerald, Utah	Oct. 16	Nov. 18	0.00½
Emerald, Utah	Nov. 15	Dec. 9	0.00½
Enterprise, Ida.	Oct. 19	Nov. 20	0.002
Friend, Ida.	Oct. 21	Nov. 24	0.002
Hale and Norcross, Nev.	Nov. 8	Nov. 29	0.03
Idaho & L. A., Ida.	Oct. 16	Nov. 17	0.005
Idaho Mont, Ida.	Oct. 30	Nov. 18	0.002
Idaho-Nevada, Idaho	Nov. 15	Dec. 16	0.002
Lehi Tintic, Utah	Nov. 8	Dec. 2	0.0025
LeRoy, Ida.	Oct. 28	Nov. 28	0.005
Mexico G. & S., Nev.	Nov. 25	Dec. 18	0.10
Military, Ida.	Oct. 25	Nov. 25	0.00025
Monarch-Pgh., Nev.	Oct. 23	Nov. 27	0.01
Naildriver, Utah	Nov. 4	Dec. 4	0.01
Nevada-Stewart, Ida.	Oct. 2	Dec. 2	0.002
New Hope, Ida.	Oct. 11	Dec. 11	0.002
Ninemile, Ida.	Nov. 2	Nov. 17	0.0015
Nonpareil, Ida.	Oct. 23	Nov. 23	0.001
North Franklin, Ida.	June 19	Nov. 23	0.005
North Star, Ida.	Oct. 10	Dec. 5	0.001
Old Veteran, Ida.	Oct. 9	Nov. 8	0.002
Ophir, Nev.	Oct. 25	Nov. 15	0.05
Raven, Ida.	Oct. 23	Nov. 20	0.001
Rico-Argentine, Colo.	Nov. 18	Dec. 5	0.01
Seg. Belcher & Midas, Nev.	Oct. 30	Nov. 24	0.02
Selma, Utah	Nov. 4	Nov. 23	0.005
Silver Moon, Ida.	Nov. 25	Dec. 23	0.005
Silver Mt., Ida.	Oct. 21	Nov. 24	0.002
Sonora, Ida.	Nov. 15	Dec. 6	0.004
Star Antimony, Ida.	Oct. 27	Nov. 17	0.001
Tobar, Utah	Nov. 2	Nov. 23	0.002
Torino, Ida.	Oct. 20	Nov. 20	0.001
Tucker, Ida.	Oct. 15	Nov. 15	0.003
Tyler, Ida.	Oct. 12	Nov. 13	0.0015
Utah Arizona, Ariz.	Oct. 31	Nov. 25	0.005
Utah Metals, Utah	Oct. 23	Nov. 18	0.002
Utah United, Utah	Nov. 15	Dec. 4	0.01
Zuma, Utah	Oct. 30	Nov. 30	0.005

Editorial Correspondence

SAN FRANCISCO—Nov. 1

Strike Situation in Amador County is improving. A long petition has been signed by merchants and miners asking for the return of men not engaged in the strike, and for protection to men that return to work. A number of men applied to Central Eureka and South Eureka, but not enough for complete resumption of extraction and milling. Sixty men started work at the Bunker Hill Oct. 30. Some of the strikers were inclined to resent the service of summons to appear in U. S. District Court to show cause why they should not be permanently enjoined from interfering with the operation of the mines; but were quickly shown that resistance was out of the question. These men are all foreigners, but they have an attorney employed by the local union and are supposed to be advised as to the power of the courts as well as to their own rights. Injunction hearing in San Francisco has been postponed until Nov. 6.

The Mine Safety Department of the Industrial Accident Commission will temporarily be in charge of H. M. Wolfiin following the resignation of Edwin Higgins, which took effect on Oct. 31. Mr. Wolfiin was first assigned to this work which embraces the duties of chief mine inspector of the commission and representative of the U. S. Bureau of Mines in the California district. He began the preliminary investigation in 1914, which resulted in the adoption of the mine-safety rules by the commission. He was assisted in 1915 by three deputies, G. Chester Brown, Fred L. Lowell and J. W. Gebb, who continue in position. Mr. Wolfiin was advanced to the position of mine-safety engineer by the Bureau of Mines and assigned to the Pittsburgh branch at the beginning of 1916, and was succeeded as mine inspector in California by Edwin Higgins, who now accepts a position as safety engineer of the California Metal Producers' Association and a number of mines that are members of the association. At the time of the organization of the safety department of the commission and the appointment of Mr. Wolfiin, there was an expressed preference for a Western man by some of the mine owners, who were not aware that Mr. Wolfiin's home was in California and that he was a graduate of the Arizona School of Mines, as well as having the advantage of a course in Columbia University. The preference for a Western man was renewed upon the appointment of Mr. Higgins. The result of the labor of both men has been so entirely satisfactory, the system of inspection so strongly established and successfully operated, that the desire is at present stronger than ever for the appointment of someone of experience and acquaintance in California mines. At this time the appointment of a stranger, especially if he is not a metal miner, would likely meet with strong objection. The available men for the position are the three deputies now in the employment of the department, two of whom are graduates of the University of California School of Mines and the other a graduate of the Arizona School of Mines. These three men have had experience not only as practical mine superintendents, but are thoroughly familiar with the duties of mine inspection in California. The retention of Mr. Wolfiin in the position of chief inspector would be satisfactory, but it is probable that the Bureau of Mines is desirous of continuing him in the position of mine-safety engineer. The appointment of either of the three deputies would result in maintaining the Mine Safety Department on the basis upon which it has been established and a greater assurance of advancement than would the appointment of a stranger or even of a practical mining engineer acquainted with mining methods in California but unacquainted with mine-safety work.

IDITAROD, ALASKA—Sept. 20

Dredging Yields from Otter Creek for the 1916 season will be below those of the previous year, owing to the handling of lower-grade gravels. Dredge operators' profits, however, will compare favorably with 1915 profits, owing to reduction in thawing costs, through improvements in boilers and equipment and the use of water for stripping the moss and overburden, employing the sun's rays to aid the steam points in their work. The yield of the hydraulic mines in this section was reduced by shortage of water. During the open season, now drawing to a close, this camp has had in operation two gold dredges of the continuous-bucket-line type, one dragline scraper with portable washing device, three hydraulic mines, four scraping plants and several smaller enterprises, and with few exceptions the operators have had a prosperous season. Rainfall has been less than average this year, which has been a drawback to hydraulicking but has not affected the dredging operations. Owing to the longshoremen's strike at Pacific Coast cities, great inconvenience and expense was experienced through lack of materials and supplies. As an illustration: J. E. Riley and associates are building a new 2½-cu.ft. dredge of the Union Construction Co. flume type. This dredge weighs about 200 tons complete, which represents only a small portion of the tonnage shipped to this camp this year. Had this material come through promptly this dredge would have been in operation by August and would have given a good account of itself this year. As it is, they are still short some material and from present indications will be unable to get more than a try-out this season.

A New Scraping Device was experimented with this season by J. E. Riley and associates, which if successful will enable the operators to handle much lower-grade gravels in the future. This machine is built much on the principle of the dragline scraper, the difference being that the washing device is stationary and the scraper travels from the point of loading to the hopper on trolley and cable, which is tightened by the drum on the scraping engine after the scraper has been loaded. The main dragline which loads the scraper also acts as hoist line when scraper is ready to be run up the trolley line to hopper. The scraper is placed in the cut by means of a spring line, which acts on the trolley line from the main engine. The experiment was conducted under the hardest possible conditions, the gravel being tight and packed with clay and it was found that the ordinary 8¼x10-in. engine could not develop sufficient power to load scraper properly nor to tighten the trolley line sufficiently to give necessary run-back. Under proper conditions and with the right set-up, the aërial scraper may be entirely successful and will reduce the cost of scraping nearly 50%. The future of this camp for several years to come is bright. The day of the pick-and-shovel miner here, as is the case in all the older camps in Alaska, is past and is being replaced with machinery that makes it possible to work at a profit ground of such low grade that the old-time miner was compelled to leave it.

BUTTE—Nov. 2

Examinations in Mine-Rescue Work and also in first-aid work will be held in Butte by H. J. Rahilly, mining engineer of the U. S. Bureau of Mines; Mr. Rahilly is at present in Butte to conduct examinations among the classes conducted for the past few months by J. L. Boardman. Those passing the examination will receive a Bureau of Mines certificate to that effect. The classes have been regarded as a great success.

Water-Power Development in Montana and other states is the object of the newly formed Intermountain Power Co. organized under the laws of Montana. Its principal office will be in Butte. Its capital stock is $500,000, comprising 5,000 shares of a par value of $100 each. The incorporators are C. F. Kelley, Charles J. Kelley, John Gillie, L. O. Evans and Eugene Carroll, all well-known Butte mining and business men.

Progress in Safety-First and first-aid propaganda is being made at Butte. In order to prepare the younger generations for the tasks they will soon be called upon to perform, the Anaconda Copper Mining Co., upon the request of Butte school authorities, has inaugurated a system of instruction which will benefit both the company and its future employees. J. L. Boardman, of the company's safety bureau, recently delivered his first lecture at one of the Butte schools, in which he drew attention to the most common causes of every-day accidents, illustrating each with a story. He also pointed out how a little thought along lines of safety first might have avoided most of such accidents. After the lecture committees of the pupils were selected to make notes during the week of instances which come under their attention in which the application of safety-first principles averted accidents and other instances where failure to apply them caused such accidents. The committees will read and discuss the results of their findings at the next meeting. It is the intention to have the lectures and the forming of safety-first committees extended to all the public schools of the city.

DENVER—Nov. 1

Threatened Strike of Miners at Leadville has been put off indefinitely. It is understood that the union officials have requested the state's Industrial Relations Commission to visit the district and to render its report on local wage conditions. According to the state law, the miners could not strike and have any redress in the courts if they do not first submit their grievances to this committee. The committee itself has only an advisory or persuasive authority but it has been instrumental in amicably settling a number of controversies since its establishment less than two years ago. Meanwhile union meetings are being held and an effort is being made to induce all the district's miners to become members.

Radium Reduction is the plan of a group of Eastern men who are reported as proposing the establishment of a plant in Denver to handle ores to be mined in Montrose County. Possibly the company will secure the plant erected in Denver by the National Radium Institute in which the Bureau of Mines conducted its research work that led to the publication of its process for reducing radium. This company's arrangement with the Federal Bureau will terminate Dec. 1 and the entire plant will be for sale, probably. The headquarters and laboratories of the Bureau are now at the School of Mines, Golden. Fred Carroll, state commissioner of mines, has recently inspected the carnotite fields and he reports that the firm of Fuller, Beebe & Wilson, of Cleveland, Ohio, has erected a small concentrating plant for carnotite ore at Saucer Basin.

SALT LAKE CITY—Nov. 2

A Large New Tailings Dam is to be constructed by the Utah Copper Co. to extend the tailings pond from the Magna and Arthur mills; other improvements and changes at Garfield are also contemplated. These improvements will cost approximately $1,000,000. The dam will be extended to a point opposite Washington St., making an area for impounding tailings of about 1,400 acres. The present dam is 40 ft. high in places. A number of buildings, including the Western Pacific depot and freight house, baseball park, jail, Garfield garage, Miller-Cahoon lumber yard, ice houses, etc., must be removed. It will also be necessary to shift a number of miles of railroad track. Both the Western Pacific and the Salt Lake Route tracks must be moved in a curve toward the lake. The Bingham & Garfield R.R. is to build a new station near the west end of the dam, and the track will be carried by a gradual approach to the top of the dam, and run northwesterly into Garfield. Waste rock from the mines at Bingham will be used for the dam filling. Several hundred men will be employed. These improvements are regarded here as reflecting the confidence the company officials have in the copper market after the war.

Ohio Copper Stockholders are to have an opportunity to redeem the property, according to a telegram received here by Frank B. Cook, of the Columbia Trust Co. By a decision of the United States District Court the shareholders' protective committee formed as a result of the efforts of the North American Liquidation Co., Inc., is permitted to redeem the property of the Ohio Copper Mining Co. for the shareholders from the purchaser who acquired it at the sale, which resulted from the foreclosure of the mortgage upon the property. Two conditions are imposed by the court in turning Ohio Copper over to the protective shareholders' committee. One is, that there shall be paid into the court whatever amount (after hearings), the court shall determine is due upon the bonds, less whatever sums have been realized from the property (a) by the trustees in bankruptcy (b) by the receivers appointed in the foreclosure proceedings and (c) by the purchaser since the foreclosure sale. The other condition is that all shareholders of the Ohio Copper Mining Co. be permitted to participate in the redemption and reorganization. The determination of the amount due and the validity of the bonds may be litigated. Hearing has been set for Nov. 13. Utah stockholders have been asked if there is any legal objection in Utah, to the use of the name of Ohio Copper Mining Corporation for the new company. A plan outlined for the reorganization includes a new corporation capitalized at 2,500,000 shares, par value $1, to be sold by an underwriting syndicate at par, less 15% commission, 1,000,000 shares to remain in the treasury, present stockholders to subscribe for the stock at $1 per share.

JOPLIN, MO.—Nov. 4

Three Thousand Smeltermen on Strike is the report from Henryetta, Okla. The workers were employed at the zinc smelteries at Henryetta and at Kusa. They demand higher wages and are members of what is known as the Working Class Union and are not associated with the American Federation of Labor. No disorders have been reported and the companies have not attempted to resume operations.

Two More Zinc Smelteries are being planned for Fort Smith, Ark. Actual construction on one, to be known as the Athletic Smelting Co., is to be started during the coming week, while representatives of Eastern smelting interests have notified the president of a Fort Smith gas company that they will be here Monday to look over a site for a 1,500-ton plant. Charles T. Orr, of Webb City, is behind the Athletic Smelting Co. He is at the head of the Wingfield-Bertha A. mines at Webb City, and the Athletic mine at Duenweg, two of the largest sheet-ground producers in this district. Other local mine owners and operators

are interested with him in the smelting venture. A tract of 37 acres has been obtained half a mile south of the Fort Smith Spelter Co.'s plant, and connection by switch will be had with the Arkansas Central R.R. The United Iron Works, of Springfield, has been awarded the construction contract. The initial capacity of the plant is to be 1,500 to 2,000 tons of ore a month, for which there will be 2,400 retorts. It has not yet been decided whether there will be four blocks of 600 retorts each or three blocks of 800 retorts. The plant is to cost about $200,000 and will give employment to about 150 men.

KANSAS CITY, KAN.—Nov. 2

Kansas Natural Gas Co. Wells in Kansas will be valueless in four years, according to the testimony of its president, Victor Hays, in the hearing on Oct. 30 before Judge Wilbur Booth, at Kansas City, Kan. About 8% of the company's production is coming from Kansas wells, and the company is trying to make up for the shrinkage by the purchase of new property in Oklahoma. It was reported on Nov. 1 that H. L. Doherty & Co. would take over this company.

ISHPEMING, MICH.—Nov. 4

Iron Ore Shipments continue at a steady pace from the mines of the Lake Superior district. There is still a shortage of boats which has tied up some of the shovels of late, in spite of the fact that a number of the smaller companies are through shipping for 1916. It looks now as if the total shipments for the year would reach 62,000,000 tons, over 50,000,000 tons having gone down the lakes already this year. Never have stockpiles been cleaned out as they are at present. Ore that has been in stock for years and had grass growing on it has been shipped. Some ore was moved from the Marquette range that had been in the piles for as long as 26 years. It has been the greatest year in the history of the iron-ore trade, but the operators are figuring that 1917 will be still greater. Lake freights are to be raised, while the costs of production will undoubtedly be higher. The mine operators have not had increases that were consistent with the advances in the price of pig iron and they will ask for considerably more next year. One large railroad operator stated this week that the lake shipments this year will fall 6,000,000 tons short of the furnace requirements for the winter, and plans are now being made to move a large tonnage of ore by rail. The only obstacle that will prevent a big movement is the shortage of locomotives. The railroads have plenty of cars, but a large number of locomotives will be required, and the roads do not see now where they can get them. It is believed by some that as much as 75,000,000 tons of ore will have to be moved in 1917. The 1916 shipments will probably be 12,000,000 tons in excess of any previous year.

WASHINGTON, D. C.—Nov. 4

A Petroleum Experiment Station, it is understood, will be urged before the appropriation committee of the House shortly after the convening of Congress.

House Committee on Mines and Mining may convene in Washington 10 days before the opening of the short session of Congress. It is understood that Representative Foster, the chairman of the committee, is anxious to have taken up at that time his bill providing for numerous changes in the mining law.

Proceedings of Pan-American Scientific Congress will be ready for general distribution Apr. 1. The papers are being edited by Dr. Glen L. Swiggett, chairman of the committee on publication. The papers in nearly every case will be printed in the language of the original. The paper of Dr. George Otis Smith on "Public Interest in Mineral Resources" has been translated into Spanish at the request of the Argentine section of the Congress.

A Large Saving to the Oil Industry of the United States has been accomplished by the work of the Bureau of Mines. This was made possible by calling to the attention of operators ready means of eliminating unnecessary waste. The Bureau is conducting a campaign looking to the introduction of the most efficient methods of drilling. These methods are expected not only to save natural gas but to protect the oil sands from premature flooding by water.

Site of Mine Experiment Station in the Northwest is still undecided though an announcement regarding the selection is expected during the next week. The Secretary of the Interior has been closely engaged in the Mexican conference and has had no opportunity to look over the voluminous data which were collected by Director Manning, of the Bureau of Mines, who recently conducted hearings in all cities making a claim for the station. While officials will not comment on the probable site of the northwestern station it is believed here that Seattle will be selected.

TORONTO—Nov. 4

Two New Nickel Refineries are now in prospect for Ontario. The International Nickel Co. is building its new refinery at Port Colborne, Ont., and expects to be in a position to turn out refined nickel in a year's time. The company will appropriate several million dollars for the plant, but it will no doubt be built in units, capable of enlargement as necessity demands. The British American Nickel Co., under the new management of E. P. Mathewson, formerly of the Anaconda, will also build a refinery, probably in the vicinity of Welland. This company will use the Hybinette process. It is understood that the company has already obtained contracts for a considerable tonnage of refined nickel for delivery in England. This is not a Government order although it is understood that the British government is interested in the company. Construction work will be carried on as rapidly as possible, and under aggressive management the prospects are encouraging. The company has plenty of ore, the main source of supply being the Murray mine; it is of rather low grade, being slightly under 3% combined nickel-copper. Unfortunately there appears to be but one Creighton mine and that belongs to the International Nickel Co.

Marked Revival in Port Arthur District is being experienced, some important discoveries of copper deposits having encouraged development. At the Tip Top copper mine, near Kashabowie, 82 mi. west of Port Arthur on the Canadian Northern, which last winter sent 340 tons of ore of good grade to the smelters, diamond drilling has shown a continuation of the vein at 1,000 ft. from the shaft and encountered a second vein 26 ft. in width, of which 15 ft. is high-grade ore. A railway spur is being built from the main line to the mine which has 20,000 tons of ore on the dump, running about 6% copper with small gold and silver content. A flotation plant and smeltery are under consideration for the spring. Another claim 3 mi. west of Mine Center is being developed under option by the Mine Center Copper Co. The vein, which was discovered last May, is wide and has been exposed for 350 ft., the ore increasing in richness at a depth of 30 ft. Three cars have been shipped to the Trail smeltery, returns from two of which were $1,030, after paying for treatment and freight. Sixty tons per day are being placed on the dump, which will be shipped at the rate of a carload per day. Four other claims in the neighborhood are being developed.

The Mining News

ALABAMA

GOODWATER (Clanton)—Large force opening graphite mines; commenced erection of mill and camp buildings.

SLOSS-SHEFFIELD STEEL AND IRON (Birmingham)—About 60 men reported caught in Bessie coal mine near Palos, following an explosion, Nov. 4. Explosion killing 92 men occurred here several years ago.

ALASKA

ALASKA GASTINEAU (Juneau)—In October milled 158,000 tons assaying $1.327 per ton; extraction, 82.49%.

ALASKA MINES CORPORATION (Nome)—Order placed with Yuba Construction Co. of California for No. 3 dredge; will dig 61 ft. below water line; manganese-steel buckets of 10-cu.ft. capacity. Dredge expected to have minimum capacity of 960,000 cu.yd. in eight months' season. Contract for manganese-steel buckets sublet to Taylor-Wharton Iron and Steel Co., Highbridge, N. J.

ARIZONA

Gila County

MIAMI COPPER (Miami)—In October made new high production record of 4,859,433 lb. copper.

ARIZONA COMMERCIAL (Globe)—Struck 3 ft. high-grade ore 10th level. Strike regarded of great importance. Installing pumps on 14th level to enable sinking to 16th.

MIAMI CONSOLIDATED (Miami)—Two Star drilling machines expected by Nov. 15. Two shifts sinking inclined shaft to reach ore said to assay 6 to 8% copper. Henry V. Snell, manager.

GREATER MIAMI (Miami)—At recent meeting elected new officers: H. S. Prince, president; R. H. Emery, vice-president; H. C. Prince, treasurer; J. G. Van Lemen, secretary.

Greenlee County

SHANNON (Clifton)—October output 757,000 lb. copper compared with 744,000 for September. Reduced output from normal caused by loss 4½ days, owing to flood in district.

Mohave County

NELLIE (Oatman)—At 350-ft. level 9 ft. of ore opened; mine 7 mi. south of town.

ELKHART (Chloride)—Unwatering nearly completed by Guggenheim representatives after which property will be sampled.

GOLCONDA CONSOLIDATED (Chloride)—Fredonia mine shaft enlarged to increase operations and new hoist installed. Plans extensive development.

MIDNIGHT (Chloride)—Drifting on orebody cut on 300-ft. level confirms opinion regarding importance of strike. Reported large shaft will be sunk for which equipment ordered.

Pinal County

RAY CONSOLIDATED (Ray)—October production 7,500,000 lb. copper.

CALIFORNIA

Amador County

CONSOLIDATED AMADOR (Sutter Creek)—Concrete-lined 9,000-gal. tank completed at 500 level; will be used as an intermediate reservoir for water pumped from lower levels. Repairing of shaft progressing.

SOUTH KEYSTONE (Sutter Creek)—Hoisting machinery formerly used at Amador Queen purchased. Grading and laying foundations in progress. Property situated between Sutter Creek and Amador and consolidated with the McIntire, Boyston and North Star claims. John A. McIntire, of San Francisco, and associates, of Tacoma, will develop the property, beginning with unwatering North Star 1,000-ft. shaft and drifting from 600 level to the orebodies of the South Keystone.

Butte County

BUMBLEBEE (Oroville)—Machinery received for installation at this property in Morris Ravine to be developed by Ford Brothers, of Los Angeles.

SOUTH BANNER (Oroville)—Expected to have electric installation completed by Dec. 1, when development on large scale is contemplated. Property in Morris Ravine.

Eldorado County

SILVA (Georgetown)—Shaft being cleaned out by company developing Georgia Slide mine.

BEEBE (Georgetown)—Unwatering of shaft is affecting domestic wells in town; several years ago when mine was in operation, wells went dry.

Plumas County

DUTRE & MAYNARD (Quincy)—Owners returned to Quincy with 132 oz. gold from last cleanup of gravel mine worked by shooter. Gold nuggets obtained worth from $1 to $200. Property situated on Squirrel Creek worked in early days by ground sluicing, but shooter method is more economical, entailing less labor.

PLUMAS BONANZA (Quincy)—Prospecting and development work to be started by W. F. Roeder, of San Francisco; owned by Roeder and the estate of Captain Reed. Since death of Captain Reed about two years ago, mine has been idle except for assessment work. Large amount of development by tunnels and a 100-ft. shaft. Property on Winters Creek.

Shasta County

MIDAS (Knob)—Crude-oil engine for this property in Harrison Gulch arrived at Redding and will be hauled to the mine in parts on motor trucks. Distance about 60 mi.; cost of transportation from Redding will be approximately equal rail freight from Eastern factory; about $650, or more than $10 a mile.

Sierra County

ALASKA (Pike City)—One-mile tunnel to be run to cut lode below bottom of 600-ft. shaft. Owned by New York corporation, with Brig. Gen. W. S. Schuyler, retired, in charge.

BLACK DIAMOND (Downieville)—Bonanza quartz uncovered near Poker Flat by Winrod & Peckwith, of Downieville, who have been prospecting ground on Hopkins Creek from which much gold was extracted by crude methods in early days.

WILLOUGHBY (Downieville)—Sold by Farrell Bros. to Benjamin Boram and associates, of San Francisco, who are preparing for extensive winter operations. Large vein carries free gold and 10-stamp mill is operating. E. M. Farrell in charge.

HERKIMER AND BUNKER HILL (Downieville)—Channel found; breasting and washing under way with good yield in coarse gold. Power hoist being installed, and working force increased. Operated under bond by Gustav De Bretteville, of San Francisco, who is personally in charge

YORK-FINNEY (Downieville) — Ore heavily studded with coarse free gold encountered by 10 ft. of sinking in bottom of old shaft through a "horse" which discouraged former owners. Vein 18 in.; increasing in width; between serpentine and slate. Hoist and electric lights installed, snowsheds erected, and compressor plant to be added at once. Shaft will be sunk to 100-ft. level before drifting on vein. Under bond to Finney Mines, Inc., of Sacramento. G. B. Morse, superintendent.

Tuolumne County

OMEGA (Sonora)—Large shoot of high-grade ore reported, carrying 6 to 8% sulphurets. Operated under bond by Lange & Husey.

BLACK OAK (Soulsbyville)—Diamond drill installed at 900 level for exploration.

Yuba County

YUBA CONSOLIDATED GOLD FIELDS (Hammonton)—Laying of first steel, Oct. 13, in construction of Yuba No. 16. Dredge is to have 16-cu.ft. buckets and two tailing stackers to be employed in placing tailing on either side of Yuba River channel, in accordance with agreement with Government for reclamation of river and preventing flood damage to property adjacent. Design and construction of dredge by Yuba Construction Co.; Newton Cleaveland, manager; Paul E. Morse, superintendent of construction.

COLORADO

Boulder County

WHITE RAVEN (Ward)—Oreshoot of good grade opened on 400-ft. level at 600 ft. from shaft.

PRIMOS CHEMICAL (Lakewood)—Large shoot good-grade tungsten ore discovered recently by lessees.

GOLD EAGLE (Caribou)—Reported bonded recently by B. A. McGee, John Carlson and R. C. Null for $25,000.

YELLOW PINE (Boulder)—High-grade silver ore opened on Lucky Seven lease. In Vancleuse vein, 3-ft. shoot assaying $100 in silver discovered.

Clear Creek County

RAYMOND TUNNEL (Georgetown) — Shoot good grade ore carrying gold, silver and copper opened at depth of 1,000 ft. Property just south of Capital mine where rich gold ore discovered recently.

Gilpin County

INCIDENTAL (Central City)—Opened 1-ft. shoot heavy iron sulphide ore rich in copper.

Lake County

IBEX (Leadville)—Regular shipments being made, stated to be largest production in history.

IRON-SILVER (Leadville)—Will move its offices from Oro in upper California Gulch to Leadville. Reason assumed to be exhaustion of orebodies in immediate vicinity of old headquarters; will continue to operate other portions of its large holdings, more tributary to Leadville.

Ouray County

GOLD CROWN (Ouray)—New capital secured and milling plant will be completed at once.

SUMMIT COPPER MINING AND MILLING (Ironton)—Driving Koehler tunnel on San Antonio group resumed. Property near Red Mountain on line between Ouray and San Juan counties.

Park County

GOLD SLIDE (Alma)—Shaft will be sunk 100 ft. by contract. Bids being received.

Saguache County

MANITOU TUNNEL (Bonanza)—Tunnel now in 800 ft. Driving temporarily suspended. Tunnel will cut at depth veins in Manitou Basin. Manager, John Ashley.

EXPRESS-HEADLIGHT (Bonanza) — Property 5 mi. south of Bonanza worked under direction of Manager McKenzie. Steam hoist and compressor installed at shaft and drifting on 100-ft. level under way. Some high-grade gold ore shipped.

San Juan County

LEE & KLONDIKE (Silverton)—Will be worked during winter.

BUFFALO BOY (Silverton)—Contract let to drive drift 100 ft.

CROWN JEWEL (Silverton)—New oreshoot opened in development work on Emerald claim.

SILVER LEDGE (Chattanooga)—Mill operating steadily. About 12 cars concentrates shipped monthly.

DAVY LEASING CO. (Silverton)—Regular shipments being made to Silver Lake milling plant for treatment.

GENESEE (Ironton)—Low-grade ore from this property near Red Mountain sent to Silver Lake custom mill and high-grade to Durango smelting plant.

HAMLET (Howardsville)—Mill completed and running satisfactorily. Sufficient ore developed in mine to insure steady operation. Arrangements made for winter work.

GOLD KING (Gladstone)—Mill resumed operations after six weeks' shutdown for repairs. Mine development work continued. Tonnage will be increased. J. H. Slattery is manager.

SUNNYSIDE (Eureka)—Twenty cars concentrates shipped during second half October. Louis Wambsgantzs killed by falling rock while making tram repairs near portal of Terry tunnel.

Summit County

MICHIGAN (Kokomo)—Regular shipments ore being made. Crew of 30 men employed.

WILFLEY (Kokomo)—Daily production 50 tons good-grade zinc ore made. Reported one-quarter million tons developed.

WELLINGTON MINES (Breckenridge)—Over 2,500 tons ore and concentrates shipped September. New shaft being sunk near western end to prospect virgin ground.

FORTUNA (Frisco)—Strike of good-grade ore made recently. New capital invested and work will be conducted on larger scale. Mine on upper North Ten Mile Creek.

EXCELSIOR (Frisco)—Development work under way for some time and considerable tonnage ore blocked out. Mine equipped with compressor, drills and 50-ton milling plant. Operated by lessees under management of Eyvind Flood.

PIONEER CONSOLIDATED (Breckenridge)—Milling plant alterations completed. Will begin operation as soon as pipe-line repairs completed. Snow sheds, timber shed and blacksmith shop being built at tunnel portal. Bids received for extending tunnel, now in 60 ft.

Teller County

LAST DOLLAR (Victor)—Electric hoisting plant and compressor to be installed.

PORTLAND (Victor)—Development in ore on 19th level progressing satisfactorily.

CRESSON (Cripple Creek)—New high-grade oreshoot opened on the 13th level.

IDAHO

Blaine County

FEDERAL MINING AND SMELTING (Hailey)—New mill at North Star mines completed and operating. E. Percy Smith, superintendent.

Shoshone County

SILVERADO (Osburn)—New mill will soon be operating. A 4,000-ft. tunnel cut vein 1,200 ft. below surface and drifts developed orebody 900 ft. long, 18 in. to 10 ft. wide assaying average 4% lead and 8 to 10 oz. silver per ton. Winze sunk on ore 110 ft. Dr. W. H. Farrar, manager.

MICHIGAN

Copper

ISLE ROYALE (Houghton)—Now shipping over 3,000 tons daily to mill.

INDIANA (Rockland)—Drill down 40 ft. on Butler lode shows good copper indications.

MOHAWK (Mohawk) — Considerable additions made to mine crew to increase November output.

HANCOCK (Hancock)—Reported October output broke record with production refined copper over 400,000 lb.

FRANKLIN (Demmon)—Increase of rock tonnage due to installation of endless-rope tram haulage, which seems to work satisfactorily.

KEWEENAW (Phœnix)—Because of the shortage of labor, unable to get required rock tonnage for mill to run steadily for even one shift.

CALUMET & HECLA (Calumet)—Work is going ahead rapidly in clearing site for extension of reclamation plant at Lake Linden, and also for the foundry extension at the mine.

WHITE PINE EXTENSION (Ontonagon)—Hundred-ton experimental stamp mill will not be erected till spring. Drifts on 200-ft. level reported in rock carrying 30 lb. copper per ton.

NEW BALTIC (Baltic)—Shaft down about 40 ft.; walls have been standing so firmly that it has not been necessary to timber as yet; ledge should be encountered within next 10 ft. and drilling begun.

CHEROKEE (Houghton)—Some good ground encountered in crosscut driven at 218-ft. level to find width of vein, apparently about 47 ft. As soon as the width is definitely ascertained, sinking will be resumed.

MICHIGAN (Rockland)—Now almost through the lode—supposed to be the Evergreen—with the main crosscut finding the width to be about 36 ft. After the crosscut has been driven far enough so that the work will not interfere, some drifting will be undertaken. Work on hanging wall of the Algomah amygdaloid is encountering leaner ground, same being true of western drift of the Baltic lode. Development work is expensive at this property as there has been so much dead work in the way of crosscuts. Stamp mill rehabilitated and will be ready to go into operation in the spring; mill was complete some time ago, but has been remodeled.

MINNESOTA

Mesabi Range

FRANTZ (Buhl)—Mine to be reopened shortly; idle two years. Underground property. M. A. Hanna Co. will be the operators and will employ about 100 men.

WEBB (Chisholm)—Shipping has stopped for the year and concentrator and washing plant closed. Full crews employed underground and trestles in place for winter stocking.

SHENANGO FURNACE CO. (Chisholm)—Last ore of the year has been shipped. Underground mines will work throughout the winter. The five Shenango boats now carrying ore for independent companies.

CHISHOLM (Chisholm)—Operations resumed. Ore being hoisted through "B" shaft of Monroe mine. Chisholm shaft will be ready for use about Jan. 1; much of the steel has been put in place in the shaft; concrete now being poured.

MISSOURI

Joplin District

RAMAGE (Joplin)—Will start big West Joplin plant on Nov. 11 after two months' shutdown. Mill has capacity of 1,000 tons daily. H. H. Hartzell is now superintendent.

W. M. SHERIDAN (Joplin)—Rushing work on new mill near Cardin, Okla. Will be ready in 30 days. Preparatory mining operations disclosing rich ore.

E. J. PRATT (Webb City)—Made fine drill strike on lease adjoining town of Baxter Springs, Kan. Blende shown at two levels. Will mean an extension of Picher-Cardin field to the north.

PRAIRIE OIL CO.—Has taken leases on large acreage near Neosho and will drill for oil and gas.

BUDD M. ROBINSON (Joplin)—Has shaft in ore on newly developed tract northwest of Cave Springs. Century Zinc Co. has sublease and has eight good drill holes.

MONTANA

Jefferson County

BOSTON & CORBIN (Corbin)—As result of installation of flotation in mill, production in first half of October was 32,000 lb. of copper and 2,117 oz. of silver—an increase of 28% over preceding similar periods.

Lincoln County

IN TROY DISTRICT there is a greater activity than at any time in its history. Togo company is driving tunnel to reach vein, 2 ft. wide on surface, carrying silver-lead ore running as high as 400 ounces of silver per ton. Silver Tip company has let contract for 900 ft. of crosscutting to reach another rich silver-lead vein. At Sylvanite property, 20 mi. north of Troy, equipment for developing gold vein is being installed. The most extensive work in the district is carried on by Snowstorm Mines Consolidated Co., which is building a railroad, power plant, mill and other equipment for operation of the Banner & Bangle mines.

Powell County

B & B (Avon)—Shipping ore assaying 6% copper and $4 to $8 gold per ton. Recent shipment netted $15 per ton. Preparing to sink 200 ft. deeper to open orebody.

Silver Bow County

BUTTE-GREAT FALLS (Butte) — Work at properties in extreme northern section of Butte district discontinued until assessment of 5c. a share can be collected.

DAVIS-DALY (Butte)—Preparations under way for treatment of zinc ores at Ophir concentrating mill of Butte-Detroit Co. Flotation unit being installed, planned to treat from 100 to 150 tons daily.

BUTTE-MONITOR MINING CO. (Butte)—After two months' shutdown, driving of tunnel resumed; now in 800 ft. It is planned to drive tunnel 3,500 ft. Property in southeastern section of Butte district. No veins as yet encountered in tunnel.

TUOLUMNE (Butte)—October production was twice that of September. Output in November is expected will average at least 150 tons per day. At company's Butte Main Range and Colusa-Leonard Extension properties in eastern section, development is progressing.

NORTH BUTTE (Butte)—Quarterly report, Sept. 30, shows production of 5,953,985 lb. of copper, 247,833 oz. silver and 402.53 oz. gold. Development during quarter: Crosscuts, 2,254 ft.; drifts, 1,630 ft.; raises, 1,409 ft.; shaft, 223 ft.; stations, 46 ft.; total, 5,562 lin.ft. Work has opened additional ore in all the veins exploited at company's properties on Anaconda Hill. Development continuing in company's properties in eastern section.

ANACONDA (Butte)—The Lexington mine and other property of the moribund Atlantic Mines Co. were sold Nov. 1 at public auction to the Anaconda company for $673,717. Under terms of sale stockholders will receive $12.50 a share in cash. The Lexington will be exploited by new owners chiefly for its zinc ores. In lower level of Leonard mine, body of 6¾% copper ore cut for 20 ft. on 2,800 level. Copper production of company's Butte mines in October estimated at 31,500,000 lb. as against 24,900,000 lb. for this month last year.

MINES OPERATING CO. (Butte)—Incorporated under laws of Delaware with capitalization of 100 shares, par $1,000, to operate property of defunct Butte-Duluth Mining Co. in eastern Butte district. Officers and directors are: Alfred Frank, of Salt Lake, president and general manager; C. W. Whitley, of Salt Lake, general manager for the American Smelting and Refining Co., vice-president; H. A. Frank, of Butte, secretary; John MacGinniss, of Butte, and E. L. Newhouse, Jr., of Salt Lake. About 50 men at work mining. Ore averaging 1.4% copper will be leached in practically same manner as formerly, but copper precipitation will be effected by addition of metallic iron, instead of by electrolysis.

NEVADA

Clark County

BIG CASINO (Searchlight)—Sinking main shaft 300 ft. to 750-ft. level to develop additional orebodies. Sixteen men employed underground, three shifts. Walter W. Wishon, manager.

Esmeralda County

MERGER MINES (Goldfield)—Crosscutting from east shale contact drift, to south on 1,170-ft. level St. Ives claim.

BLUE BULL (Goldfield)—On 700-ft. level at point about 700 ft. easterly from shaft encountered new vein of encouraging character.

JUMBO JUNIOR (Goldfield)—On 880-ft. level drift has progressed 60 ft. in vein yielding assays up to $30 per ton. Winze has been started showing improved conditions.

GOLDFIELD CONSOLIDATED (Goldfield)—In September total production 25,800 tons; net realization, $16,072. Total mining expense, $2.55; milling, $2.12; total net costs, $5.83 per ton.

KEWANAS (Goldfield)—Recent report states operations on 840-ft. level have developed limited tonnage of low-grade ore amenable to flotation treatment. Ore of shipping grade encountered, but "bunchy" thus far.

Humboldt County

HUMBOLDT TUNGSTEN (Lovelock)—Ore from mine now going to mill bins of new 75-ton plant at Toulon. Plant erected by Stearns-Roger Manufacturing Co. and is practically completed.

ROCHESTER MINES CO. (Rochester)—Contract for 12,100-ft. aërial tram from mine to mill let to St. Louis firm. To be completed in 60 days at cost of about $35,000. Company estimates saving of $24,000 per year.

ST. ANTHONY MINES CO. (Fahning)—On 200-ft. level, vein is 7 ft. wide, of slightly better grade than at surface. On surface about 2,000 ft. from present workings another tungsten vein has been uncovered, showing about 4 ft. of ore. About 30 men employed.

Nye County

TONOPAH ORE PRODUCTION for week ended Oct. 28 was 9,959 tons, valued at $195,202, compared with 9,864 tons for week previous. Producers were: Tonopah Belmont, 2,878 tons; Tonopah Extension, 2,380; Tonopah Mining, 2,250; Jim Butler, 1,150; West End, 675; Halifax, 215; Rescue-Eula, 190; McNamara, 90; miscellaneous, 125 tons.

McNAMARA (Tonopah)—Present face shows 6 ft. milling ore; regular shipments being made to West End mill. Working through West End shaft.

TONOPAH EXTENSION (Tonopah)—In September mine and mill receipts were $146,638; current expenses, $81,286; operating profit, $65,352.

WEST END (Tonopah)—The old Ohio shaft on California claim repaired to 500-ft. point. Is about 750 ft. deep. Expect to resume sinking by end of November.

TONOPOH EXTENSION (Tonopah)—September profit $64,896 from 9,545 dry tons, yielding 1,564.76 oz. gold and 170,614 oz. silver. Main operations are from 950-ft. level, No. 2 shaft, to 1,540-ft. level Victor shaft.

WHITE CAPS (Manhattan)—The west 210-ft. level and 310-ft. levels connected by raise in ore averaging $17 per ton. Grading for mill, which will be moved to point near shaft. Preparing to sink shaft to 435-ft. level.

Storey County

OPHIR (Virginia)—Joint Con. Virginia west crosscut advanced to 441-ft. point.

CON. VIRGINIA (Virginia)—Joint Ophir west crosscut advanced to 310-ft. point.

ANDES (Gold Hill)—Saved 47 cars of ore from 350 level. Returns of $840 for September shipments to Selby.

UNION CON. (Virginia)—Extracted from 2,500 level 22 cars of ore, averaging $18.30, and 47 cars, $16.50. Prospecting from 2,300 to 2,700 levels.

JACKET MILL (Gold Hill)—Received 420 tons ore from surface dump, running mill three full days, cyanide plant also operating. Shipped bar of bullion.

COMSTOCK PUMPING ASSOCIATION (Virginia)—One of new vertical pumps installed below level of 2,700 station of Mexican-Ophir winze. Removing station pump from south compartment preparatory to installing another vertical pump. Overhauling other pumps of the system.

NEW MEXICO

Grant County

SANTA RITA DEVELOPMENT (Santa Rita)—W. H. Weed announces development started by diamond drilling with three drills, driving 1,000-ft. tunnel and active mining on Ruddle claims. Hoist machinery placed and ore shipments expected in 30 days.

PENNSYLVANIA

BETHLEHEM STEEL (Bethlehem)—Awarded $2,000,000 contract to Dravo Contracting Co., Pittsburgh, for erection four blast furnaces, open-hearth plant, blooming and plate mills at Sparrows Point, Md., for Maryland Steel Co. works.

UTAH

Beaver County

MONTREAL (Milford)—From 50 to 100 tons low-grade copper ore produced daily. Ore carries excess of iron, largely as magnetite. Railroad spur being built to mouth of tunnel. Property being worked by Alfred Frank, of Salt Lake, and John MacGinnis, of Butte.

Box Elder County

LAKEVIEW (Saline)—Nine cars of ore mined during October. Five cars of lead ore and zinc ore shipped, and four broken awaiting shipment. Zinc averaged 35% and lead between 25 and 40%. Twenty lessees working. S. S. Arentz, manager.

Juab County

TINTIC SHIPMENTS for October amounted to 788 cars. There were 22 shippers.

MAY DAY (Eureka)—During September 6 cars shipped, and up to Oct. 26, four cars. Company has paid two dividends totaling $40,000 this year.

CENTENNIAL-EUREKA (Eureka)—Shipments being increased. Week ended Oct. 27, shipments amounted to 26 cars. Much development being done.

EUREKA HILL (Eureka)—Ore running high in silver with some copper and lead opened on Pierce-Hardy lease, on what is thought to be old Silver Gem vein, which in past produced much ore.

IRON BLOSSOM (Silver City)—Drifting from 1,300 level of winze in north end of property to reach copper orebody, after which sinking in winze to be continued. Siliceous ore amounting to 100 tons being shipped daily.

EAGLE & BLUE BELL (Eureka)—Additional connections, made recently between Eagle & Blue Bell and Victoria workings, facilitate handling of ore from latter. Victoria section producing about 200 tons weekly. W. Owens, superintendent.

Millard County

ANTELOPE STAR (Black Rock)—Property, 9 mi. west of Black Rock on Millard-Beaver county line, attracting attention. Lead ore of milling grade opened at intervals for 1,800 ft. along strike; higher grade portions in the milling ore. Two different veins.

Salt Lake County

SHIPMENTS FROM ALTA for week ended Oct. 27 were between 15 and 18 cars; principal shippers were the South Hecla and Michigan-Utah. At present there is shortage of teams. Supplies are being brought up for the winter. Regular back haul price for freight has been $6 per ton. Recently as high as $10 for the 9-mi. haul has been paid.

UTAH COPPER (Bingham)—Production for October estimated at about 21,000,000 lb.

SOUTH HECLA (Alta)—Much ore broken. Mine bins full and excess stored underground. George H. Watson, general manager.

UTAH CONSOLIDATED (Bingham)—Current rate of production reported at approximately 1,000,000 lb. copper a month, and 1,500,000 lb. lead. Company derives additional income from 8,250 shares Anaconda stock.

PERUVIAN CONSOLIDATED (Alta)—Special stockholders' meeting called for Nov. 20 to consider increase in capitalization from 450,000 to 1,000,000 shares, par value $1. Company will absorb former Miller-Peruvian, which was operating Peruvian property under lease. Adjoins South Hecla and Sells on southwest.

CONGER (Bingham)—Raise from the Montana-Bingham's tunnel now up 900 ft. Still 400 ft. to go before connections will be made with workings from which ore is being mined. Raise started in Bingham Amalgamated ground and was driven partly to demonstrate apex of a vein, which is expected to connect with old Conger stopes; also to secure ventilation, etc. Copper ore being mined in old workings at about 200-ft. depth.

Summit County

PARK CITY SHIPMENTS for October amounted to 6,321 tons of ore and concentrates; 11 shippers.

THREE KINGS (Park City)—Winze being sunk below 540-ft. level down 110 ft. Objective point contact of limestone with underlying Ontario quartzite. Ore makes on and near this contact in neighboring properties.

DALY WEST (Park City)—Ore being mined on 1,700-, 1,900- and 2,000-ft. levels. Between 100 and 125 tons of ore milled daily. Some first-class ore being shipped. Production for first 10 months of year has been about 8,000 tons of ore and concentrates.

SILVER KING CONSOLIDATED (Park City)—Newly remodeled Grasselli mill and sampler being warmed up. Regular shipments over 10,200-ft. aërial tramway to be started soon. Thaynes Cañon tunnel in 800 ft. Several hundred tons of ore accumulated awaiting shipment.

Tooele County

IN DEEP CREEK there is much activity owing to new railroad, on which work has been started by the Utah Construction Co. Five miles of grading has been done, and rails and ties are arriving at Wendover. The Gold Hill terminus is to be named Goodwin, in honor of Judge Goodwin, of Salt Lake City, who has long advocated building a road into this section.

CAPELL SALT (Wendover)—Company, whose property is on Western Pacific, 120 mi. southwest of Salt Lake City, is increasing capacity. Much of the crude salt produced from the salt beds carries 90% sodium chloride.

VIRGINIA

VIRGINIA SMELTING (Norfolk)—Secretary F. A. Eustis reports recent fire started at top of sintering plant, where 2,300-volt electric power wires seriously hampered crew's efforts to extinguish. Before controlled, fire entirely destroyed screening and crushing plant and seriously damaged sintering plant. Plant operating under temporary arrangements pending sintering-plant reconstruction by contract; hoped to complete by Jan. 1.

WISCONSIN

Zinc-Lead District

WISCONSIN ZINC (Platteville)—Heavy range zinc ore proved by drill over 700 ft. in length on Calvert Estate ½ mi. north of Benton. Company's two new producers, the C. A. T. and Birkbeck making large output.

LINDEN ZINC CO. (Linden)—This company, heretofore operating under lease the Campbell Magnetic Separating plant at Cuba City, has purchased the Cuba plant outright; has expended $18,000 in remodeling the machinery equipment. Capital stock increased from $10,200 to $75,000. The Linden plant will also be overhauled, making a combined capacity of 100 tons of green ore per day. Raw zinc concentrates are purchased from independent producers of the district.

CANADA

British Columbia

STANDARD SILVER-LEAD (Silverton)—Strike of 3-ft. clean lead orebody made in No. 5 tunnel. This is third important strike in last few weeks, two strikes high-grade lead-silver ore made in September in upper tunnels Alpha claim.

Ontario

IN LAKE OF THE WOODS DISTRICT a test mill run on the Cameron Island property is reported to have given returns of $29 per ton, about 62% of assay values. An increased percentage said to have been obtained by use of converter-roaster invented by Aaron Beam, of Denver.

SHAMROCK (Cobalt)—Strike of high-grade ore made on 300-ft. level.

DOME (South Porcupine)—October production, $185,000 from treatment of 40,200 tons of ore; average value, $4.60 per ton; working cost, $2.69 per ton.

NEWRAY (Porcupine)—Diamond drilling has disclosed vein 12 ft. wide at 600-ft. level. Core assays are reported at $23.90 to the ton. Three veins found on surface cut by diamond drill.

INTERNATIONAL NICKEL CO. (Port Colborne)—Surveys for refinery completed and excavation begun so as to have the foundation completed before freezing sets in. It is expected to have the plant ready for operation within 12 months. The plant will be constructed in units; number of employees at outset will be about 300.

VACUUM GAS AND OIL CO. (Thamesville)—Recently shipped three cars of oil and has four wells pumping and four others which will be in operation about the middle of November. Company has secured new leases in the Thamesville, Brooke, Kent and Elgin oil fields and in the Tillsonburg, London and Bayham gas pools. Contract made with a pipe-line company to handle gas output.

HOLLINGER CONSOLIDATED (Timmins)—For four weeks ended Oct. 6, gross profits $241,293 from 49,770 tons of ore; average value, $9.07 per ton; working cost, $3.86 per ton milled. Mill ran 90.5% of possible time. This is the first time that the increased dividend has been earned since the merger, the deficit to date being $239,740. The crosscut from the Hollinger ground has reached the Millerton, and it is announced that No. 12 and No. 41 veins are the same body extending for about 1,000 ft. Central shaft is now down to 800-ft. level. Steel headframe, hoisthouse and crusher station completed. New mill nearly closed in and first unit is expected to be ready in March.

CUBA

CANDIDA (Los Acostas)—This Pinar del Rio copper mine recently shipped a cargo of 1,100 tons of high-grade ore to the United States on the Norwegian steamer "Imperator," making a total of about 3,000 tons from this one orebody.

COSTA RICA

MILLION-ACRE OIL TRACT optioned by Washington S. Valentine of 17 Battery Place, New York, for American syndicate.

CHOSEN

ORIENTAL CONSOLIDATED (Unsan)—Cable estimate, October cleanup $121,200. Details of September bullion yield were: Tabowie mill, $25,869; Taracol mill, $25,398; Maibong mill, $19,649; Taracol cyanide plant, $49,224; Maibong tube-mill plant, $3,696; total, $123,836; tons milled, 26,391. Rainfall below normal and additional power contracted at 1½c. per kw-hr. from Okura & Co. as against regular price of 2c. Cholera, which has been raging in Japan, spread to Chosen in September, but is expected to be checked by the cold season. No cases north of Seoul as yet and none in Unsan district since 1902.

The Market Report

Metal Markets

NEW YORK—Nov. 8, 1916

An extraordinarily large business, with spectacular features, was done in copper, the price for which advanced sharply. Good business was done in lead and zinc, lead at unchanged prices and zinc advancing slightly.

Copper, Tin, Lead and Zinc

Copper—A very large business was done, both for domestic and foreign account, the aggregate of sales being upward of 125,000,000 lb., without any doubt. The demand was both persistent and insistent. A good many buyers had manifestly overstayed their market and had been compelled finally to buy on the best terms they could get. This was exhibited in the demand for early copper, but producers could not furnish much of that in view of the scarcity of their supplies. January copper, and indeed copper for delivery during the first quarter of 1917, has now become very tight. During the last week a large business was done for first-quarter and second-quarter delivery, the major market covering both of those periods. Some business for the second half of 1917 was done, but nowhere near so much as in the previous week.

Prices rose right from the beginning and exhibited wide variations for same delivery, not only between different times of the day, but also between different offices at the same time. Monday was especially a big and excited day. On that day the supply of first-quarter copper became practically cleaned out, and the price advanced to 29c., r.t., at the close. Sales of November-December copper were made at 30c. in considerable quantity; i.e., several hundred tons. At the close of the week, November-December was about 30c.; January, 29¾c.; first-quarter, 29@29½c.; second-quarter, 28½@29c., all regular terms.

Copper Exports from Atlantic ports in October were 32,975 gross tons.

Copper Sheets, the base price is nominally 37½c. for hot rolled and 38½c. for cold rolled. Prompt deliveries command toll. Wire is stronger, 33@33½c. nominal.

Tin—A small but steady business was done. At the beginning of the week spot was 41¾c.; futures, 40¾c.; at the close, spot, 42¾c.; futures, 41⅝c.

Visible Stocks of Tin Oct. 31 were: London, 7,375; Holland-Banka and Billiton, 2,194; United States, 7,846; total, 17,415 gross tons. This is an increase of 1,223 tons during October; and of 4,261 tons over Oct. 31 last year.

Tin Exports of the Federated Malay States in September were 3,636 gross tons; for the nine months ended Sept. 30 they were 32,610 tons, being 2,230 tons less than in 1915, and 4,088 tons less than in 1914.

Lead—This market was quiet and firm. Some large orders were placed and the aggregate of business was probably a little larger than in the previous week. Canada was a persistent buyer. Some Russian orders for shipment to Vladivostock were placed and more are said to be pending. The price quoted for lead at Pacific Coast ports is 7¼c.

Spelter—A small business in common spelter was done at advancing prices. A considerable business in brass special at about 10¾c. was reported, and there was a large business in high grade, the price of which is still quoted at about 15c.

Zinc Sheets—The base price has not changed from that quoted last week, the quotations being $16 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

Other Metals

Aluminum—The demand continues strong and supplies show no increase. Quotations are as per last week, 64½@66c. per lb. for No. 1 ingots, New York.

Antimony—Spot was quoted at 12¾@13¼c., but one of the largest interests made no offers to sell at less than 13½c. for future delivery. In general, the market for futures was rather firmer.

Imports of ore, matte, etc., containing 1,226,400 lb. of antimony from Alaska during the eight months ended Aug. 31 are reported by the Department of Commerce.

Quicksilver—Firm at $80. Stocks in New York reported small. San Francisco reports, by telegraph, $75@76, market very dull.

Minor Metals—Current quotations for **Bismuth** are $3.15@3.30 per lb., New York—**Cadmium** is quoted at $1.30@1.50 per lb.—**Cerium**, electrolytic, is sold at $8@9 per lb.—**Cobalt Metal** is quoted at $1.35 per lb.—**Magnesium** is steady, with sales at $3.50@3.75 per lb. for 99% pure—**Selenium** is from $3 up to $5 per lb., according to size of order.

Gold, Silver and Platinum

NEW YORK—Nov. 8

Gold imports at New York from Ottawa have been suspended for the present.

Gold in the United States Nov. 1 is estimated by the Treasury Department as follows: Held against gold certificates outstanding, $1,770,202,919; in Treasury current balances, $268,965,399; in banks and circulation, $660,968,658; total, $2,700,136,976. This is an increase of $502,023,214 over Nov. 1 of last year.

Silver has rapidly advanced owing to an improvement in the Eastern Exchanges. It is reported that considerable buying has been done by both India and China. Heavy sales by China in the last few months may occasion purchases in quantity to replace the depleted metal in that country.

Coined Silver in the United States Nov. 1 is estimated by the Treasury Department as follows: Standard dollars, $568,270,319; subsidiary coins, face value, $189,695,716; total, $757,966,035. Of the dollars, $470,021,918 are held against silver certificates outstanding.

Platinum—Market again stronger; quoted at $95@100. The jewelry trade continues to use considerable quantities.

Palladium—Quoted at $75 per oz.

Zinc and Lead Ore Markets

Platteville, Wis., Nov. 4—Quotations of the district are according to the following figures: Base price per 2,000-lb. ton for material assaying 60% zinc is $70 for premium ore down to $65 for medium grade ores. For material assaying 80% lead the base price per 2,000-lb. ton is $80@82. Shipments for the week were 2,677 tons of zinc ore, 77 tons of lead ore, and 828 tons of sulphur ore. For the year, to date, the figures are, 109,403 tons of zinc ore, 3,725 tons of lead ore, and 27,034 tons of sulphur ore. Shipped during the week to separating plants, 4,462 tons of zinc ore.

Joplin, Mo., Nov. 4—Price quotations per 2,000 lb.: Blende, high, $81.60; 60% zinc, premium ore, $80; medium grades, $79@72; low, $70. Calamine, per ton 40% zinc, $45@38. Average selling price, all grades of zinc, $63.95 per ton.

Lead, high price, $87.50; base, $87@84; average selling price, all grades of lead, $84.14 per ton.

Shipments of the week: Blende, 6,730 tons; calamine, 2,005 tons; lead, 1,356 tons. Value, all ores the week, $672,680; 44 weeks, $31,407,290.

The market price of blende assumed a peculiar spurt awhile on Friday afternoon, with an exceptionally strong demand at advancing prices, but by night had quieted down and several buyers had been withdrawn from the market. Blende ore as low as 49%, with over 16% iron received bids of $60, $70 and $77 within the afternoon. The advance was so rapid and the buyers out of the market before the fact was fully known, sellers not knowing the situation were reporting rumors tonight of $82.50 to $85, of which there is no basis but rumor. Lead demand is creating new records in prices almost every week, with a general upward tendency. American Zinc, since acquiring the Granby lead smelters, is a strong competitor of the Eagle-Picher company.

The low stage of water continues a depression to production.

Other Ores

Manganese Ore—By a clerical error manganese ore was quoted in this column last week at 70@75c. per unit, delivered at tidewater ports, when 66@65c. was intended. This week we quote 60c.

Imports included 280 tons of manganese ore from Liverpool at Baltimore.

Tungsten Ore—Business continued very active, $17 per unit being paid for prompt delivery. There are considerable inquiries in the market for further forward contracts, but negotiations are still pending. Arrivals during the last week were absorbed with exception of a small tonnage. We quote the market at $16.50@17. Ferro-tungsten continued at $2.60 per lb.

Molybdenum Ore—Prompt molybdenite is still hard to obtain. We quote $1.70@1.80 per lb. MoS_2. Ferromolybdenum active at $4 per lb. for prompt, and $3.65 for forward.

Antimony Ore—Considerable inquiry, but little has been obtainable. Small quantities of high grade reported sold at $1.60 per unit.

Iron Trade Review

NEW YORK—Nov. 8

There is no change in the general conditions of the iron and steel markets from last week.

The main point of interest is the great activity in the pig iron market, with the rapid rise in prices, which are now from $2 to $2.50 above those of a week or two ago. Buyers are not, apparently, pressing so much for immediate supplies as seeking to provide for 1917 needs.

There is some improvement in orders for structural steel, though many projects are held back on account of high prices.

PITTSBURGH—Nov. 7

The sharp advances in pig iron have continued. Southern iron has advanced from $17 to $20 or

SILVER AND STERLING EXCHANGE

Nov.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Nov.	Sterling Exchange	Silver New York, Cents	Silver London, Pence
2	4.7569	68⅛	32 7/16	6	4.7569	69⅛	33⅛
3	4.7569	68⅛	32⅛	7	...	...	33 7/16
4	4.7569	68⅛	32⅛	8	4.7569	71⅛	34⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Nov.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
2	27⅛ @28	41¾	7.00	6.90 @6.92½	10⅛ @10⅜
3	27⅛ @28⅛	41¾	7.00	6.87½ @6.92½	10⅛ @10⅜
4	27⅛ @28⅛	42¼	7.00	6.87½ @6.92½	10⅛ @10⅜
6	27⅛ @28¼	42¼	7.00	6.87½ @6.92½	10⅜ @10⅛
7	...	...	...	...	...
8	28¼ @29¼	42¼	7.00	6.90 @6.92½	10⅜ @10⅛

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" (r.t.) is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only St. Louis price is given, St. Louis being basing market. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Nov.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
2	124	119	143	180½	181½	30½	52½
3	124	119	143	182½	183½	30½	52½
4	...	...	...	...	...	...	...
6	124	119	144½	182½	184½	30½	53½
7	124½	120	146	183½	184½	30½	53½
8	124	119	147	183½	184½	30½	53½

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. Copper quotations for electrolytic are subject to 3% discount. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½ cents.

higher with practically no intermediate sales, while the local market is up $1 to $2. Steel prices are also advancing but prices are not clearly defined in some products as the mills are reserved about selling, being already committed as far ahead as is considered advisable. On Nov. 1 the iron- and steel-pipe mills advanced lap-welded pipe one point, or about $2 a ton, while steel boiler tubes were advanced two points. On Nov. 6, wire products were advanced $3 a ton, making nails, $2.85, base. The American Sheet and Tin Plate Co. has withdrawn from the market on tin mills products, being practically sold up for the half year. Its tinplate price had been $5.75 but there was not enough to go around and some of its customers have bid independents $6.25 without getting material, although independents were selling regular customers at $6.

The Carnegie Steel Co. produced 970,000 gross tons of steel ingots in October, a new month's record, and many other mills broke records. Serious fears are entertained that car shortages may curtail steel output in the next couple of months. Since Sept. 1, about 52,000 freight cars have been ordered, equal to 2% of the number in service. Deliveries would run to next October if the steel were furnished in regular course, but in the event of more serious car shortages the mills may give the steel precedence over other business, excepting that of the Government.

Fears of an iron-ore shortage are now removed, as the movement down the lakes to Nov. 1, with prospects of 4,500,000 tons in November and 1,500,000 tons by all-rail, promises 64,000,000 tons for the season. There is very serious danger of pig iron production being curtailed by shortage of coke or of cars.

Pig Iron—The market advances as soon as a few sales have been made at a given price, and following the advance of $2 a ton in all grades re ported a week ago bessemer is up $2 more and other grades $1. A consumer of bessemer who wanted 3,000 tons got 1,500 tons at $26 and immediately paid $27 to other sellers for 1,000 tons and 300 tons respectively, since when odd lots have sold at $28.50. Doubtless there is unsold capacity to the middle of next year but producers are unwilling to sell, seeing they can secure higher prices and being fearful of a coke famine and car shortages. There is scarcely any inquiry for second half. We quote: Bessemer, $28@28.50; basic, $23@24; foundry, $24@25; malleable, $23.50@24.50; forge, $23.50@24.50, f.o.b. valley furnaces, 95c. higher, delivered Pittsburgh. Low phosphorus, 0.035%, has sold at $40, furnace.

Steel—It is reported on good authority that the leading sheet producer in England, itself a producer of steel but being "controlled," recently bought 25,000 tons of bessemer sheet bars at $46, f.o.b. Youngstown, and about 10,000 tons of sheets. The market is strong at $50 for billets and $52 for sheet bars, with no regular offerings. Rods are $60@65 and ordinary forging billets $70@75.

IRON ORE

Shipments of Lake Ore continue heavy, in spite of bad weather. Shipments from Lake Erie docks to furnaces have been much delayed by short supply of cars.

Ferroalloys

Ferrovandium exports from the United States eight months ended Aug. 31 were 1,062,932 lb., which is 220,667 lb. more than for the entire year 1915.

Ferrosilicon, 50% is quoted at $98@100 per ton at mill. Bessemer ferrosilicon is from $33 for 10% up to $43 for 16% at mill.

Spiegeleisen, 20% is quoted at $50@55 per ton f.o.b. cars, according to size of order.

Ferromanganese—The market is quiet at $165 for domestic and $164 for imported, on contract, with prompt at the same level.

Coke

Connellsville—The market has stiffened further, with spot furnace bringing $7.50@8, while spot foundry is $9@10, and shipped chiefly in hopper cars. Production cannot be increased, owing to car and labor shortage while demand is heavier, regular furnaces requiring more on contract while there is demand from removed points, copper producers in the northwest being out for large tonnages of prompt. A contract for 15,000 tons a month of furnace coke over first half has been closed at about $4.

Chemicals

NEW YORK—Nov. 8

The general markets are in good shape and trade in heavy chemical is steady.

Arsenic—Business is fair, supplies better and prices steady at $6@6.25 per 100 lb., according to size of order.

Copper Sulphate—Business quiet. Prices, $10.50 @11.25 per 100 lb., according to size and terms of order.

Nitrate of Soda—Demand continues fair. Prices a little soft at $2.90 per 100 lb. for both spot and futures.

STOCK QUOTATIONS

N. Y. EXCH.†	Nov. 6
Alaska Gold M.	12
Alaska Juneau	6⅛
Am. Sm. & Ref., com.	112⅛
Am. Sm. & Ref., pf.	117⅛
Am. Sm. Sec., pf. A	99⅛
Am. Sm. Sec., pf. B	92⅛
Am. Zinc	52⅛
Am. Zinc, pf.	83
Anaconda	98
Batopilas Min.	1⅛
Bethlehem Steel	669
Bethlehem Steel, pf.	145
Butte & Superior	68⅛
Chile Cop.	23
Chino	64⅛
Colo. Fuel & Iron	54
Crucible Steel	93⅛
Dome Mines	24⅛
Federal M. & S.	18⅛
Federal M. & S., pf.	43⅛
Great Nor., ore ctf.	43⅛
Greene Cananea	53⅛
Homestake	130
Inspiration Con.	67⅞
International Nickel	51⅛
Kennecott	55
Lackawanna Steel	90⅛
Miami Copper	39⅛
Nat'l Lead, com.	69⅛
National Lead, pf.	112
Nev. Consol.	25⅛
Ontario Min.	6⅛
Quicksilver	2
Quicksilver, pf.	3⅛
Ray Con	29⅛
Republic I. & S., com.	80⅛
Republic I. & S. pf.	114⅛
Sloss-Sheffield	74⅛
Tennessee Copper	22⅛
U. S. Steel, com.	123⅛
U. S. Steel, pf.	121⅛
Utah Copper	113⅛
Va. Iron C. & C.	57

N. Y. CURB†	Nov. 6
Buffalo Mines	1
Butte & N. Y.	1⅛
Butte C. & Z.	15⅛
Caledonia	.48
Can. Cop. Corpn.	2 1/16
Cashboy	.06
Cerro de Pasco	44⅛
Con. Ariz. Sm.	2⅛
Con. Coppermines	2⅛
Con. Nev.-Utah	⅛
Crystal Cop.	.80
First Nat. Cop.	5⅛
Florence	.70
Goldfield Con.	.57
Goldfield Merger	.06⅛
Granite	.40
Hecla Min.	7⅛
Howe Sound	5⅛
Jerome Verde	1 3/16
Joplin Ore & Spel.	.45
Kerr Lake	4⅛
Magma	49
Majestic	.55
McKinley-Dar-Sa.	.58
Mother Lode	.37⅛
Nevada Hills	.22
N. Y. & Hond.	15
Nipissing Mines	8⅛
Oro	.04
Ray Hercules	4⅛
Rochester Mines	.59
St. Joseph Lead	19⅛
Standard S. L.	1⅛
Stewart	.19
Success	.37
Tonopah	5 3/16
Tonopah Ex.	5⅛
Tribullion	1/16
United Zinc	5
White Knob, pf.	2⅛
White Oaks	4
Yukon Gold	2⅛

SAN FRAN.*	Nov. 6
Alta	.04
Andes	.10
Best & Belcher	.06
Bullion	.01
Caledonia	.30
Challenge Con.	‡.05
Confidence	.20
Cons. Imperial	.01
Con. Virginia	.09
Gould & Curry	.03
Hale & Norcross	.05
Jacket-Cr. Pt.	.04
Mexican	.11
Occidental	.65
Ophir	.26
Overman	.03
Savage	‡.10
Seg Belcher	.03
Sierra Nevada	.29
Union Con.	.58
Utah Con.	.01
Belmont	4.65
Jim Butler	.91
MacNamara	.09
Midway	.23
Mont.-Tonopah	.18
North Star	.16
Rescue Eula	.27
West End Con.	.69
Atlanta	.09
Booth	.10
C.O.D. Con.	.02
Comb. Frac.	.05
D'field B.B.	.06
D'field Daisy	.05
Jumbo Extension	.31
Round Mountain	.36
Sandstorm Kendall	.04
Silver Pick	.19
Central Eureka	‡.05
Argo	.07
Ariz. Central	.10
Big Jim	1.18⅛
Lazy Boy	.06
Oatman No. Star	‡.14
Tom Reed	2.20
United Eastern	4.50
United Western	.04

BOSTON EXCH.*	Nov. 6
Adventure	3⅛
Ahmeek	106⅛
Algomah	1
Allouez	71
Ariz. Com., ctfs.	14⅛
Bonanza	.40
Butte-Ballaklava	2⅛
Calumet & Ariz.	79⅛
Calumet & Hecla	589
Centennial	21
Copper Range	71⅛
Daly West	2⅛
East Butte	16
Franklin	9⅛
Granby	93⅛
Hancock	13⅛
Helvetia	.25
Indiana	3⅛
Island Cr'k, com.	62⅛
Island Cr'k, pfd.	92
Isle Royale	34⅛
Keweenaw	5⅛
Lake	13⅛
La Salle	4⅛
Mason Valley	7
Mass	15⅛
Mayflower	4
Michigan	4⅛
Mohawk	96
New Arcadian	6⅛
New Idria	13⅛
North Butte	22⅛
North Lake	2⅛
Ojibway	1⅛
Old Colony	3
Old Dominion	72
Osceola	91
Quincy	93⅛
St. Mary's M. L.	88
Santa Fe	2⅛
Shannon	9
Shattuck-Ariz.	31⅛
So. Lake	5⅛
So. Utah	.27
Superior	15
Superior & Bost.	7
Tamarack	43⅛
Trinity	7
Tuolumne	.60
U. S. Smelting	74⅛
U. S. Smelt'g, pf.	51⅛
Utah Apex	3
Utah Con.	16⅛
Utah Metal	7⅛
Victoria	6⅛
Winona	4⅛
Wolverine	46⅛
Wyandot	1⅛

BOSTON CURB*	Nov. 6
Alaska Mines Corp.	.83
Bingham Mines	9⅛
Boston Ely	.70
Boston & Mont.	.82
Butte & Lon'n Dev.	.53
Calaveras	5⅛
Calumet-Corbin	.02
Chief Con.	2
Cortez	.30
Crown Reserve	.45
Davis-Daly	4 1/16
Eagle & Blue Bell	1 3/16
Houghton Copper	1⅛
Iron Cap Cop., pf.	6⅛
Mexican Metals	.55
Mines of America	2⅛
Mojave Tungsten	3⅛
Nat. Zinc & Lead	.61
Nevada-Douglas	1⅛
New Baltic	2⅛
New Cornelia	18⅛
Ohio Copper	.25
Oneco	.80
Rex Cons.	.45
Rilla	.10
United Verde Ext.	39⅛

SALT LAKE*	Nov. 6
Big Four	1.10
Black Jack	.06
Cardiff	6.90
Colorado Mining	.18
Crown Point	.05⅛
Daly-Judge	8.00
Emma Cop.	2.50
Empire Copper	1.25
Gold Chain	.10
Grand Central	.60
Iron Blossom	1.70
Lower Mammoth	.05
May Day	.12⅛
Opohongo	.01⅛
Prince Con.	1.32½
Seven Troughs	.04
Silver-King Coal'n.	2.90
Silver King Con.	3.70
Sloux Con.	.15⅛
So. Hecla	1.70
Uncle Sam	.06
Wilbert	.09⅛
Yankee	.16

TORONTO*	Nov. 6
Bailey	.07⅛
Beaver Con.	.40
Chambers Ferland	.15
Coniagas	4.75
La Rose	.55
Peterson Lake	.18
Right of Way	.05
Seneca Superior	‡.09
T. & Hudson Bay	73.00
Temiskaming	.60
Wettlaufer-Lor.	.08
Dome Exten.	.30
Dome Lake	.57
Foley O'Brien	.70
Hollinger	6.62½
Jupiter	.26
McIntyre	1.79
Newray	.97
Porcu. Crown	.67
Vipond	.41
West Dome	.34

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Nov. 6
Doctor Jack Pot	.09
Elkton Con.	.10
El Paso	.40
Findlay	.03
Gold Sovereign	.04
Golden Cycle	2.42
Granite	.60
Isabella	.23½
Jack Pot	.05
Mary McKinney	.30
Portland	1.93
Vindicator	1.60

LONDON	Oct. 19
Alaska Mexican	£0 15s0d
Alaska Tre'dwell	2 17 6
Burma Corp.	4 6 10½
Cam & Motor	0 11 9
Camp Bird	0 7 6
El Oro	0 8 9
Esperanza	0 10 9
Mexico Mines	3 17 6
Nechi, pfd.	0 13 6
Oroville	0 16 9
Santa Gert'dis	0 11 0
Tomboy	1 1 0

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.960
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	57.935	26.788	23.708	27.597
April	58.519	50.250	64.415	26.958	23.709	30.662
May	58.175	49.915	74.269	26.704	23.570	35.477
June	56.471	49.034	65.024	25.948	23.267	31.060
July	54.678	47.519	62.940	25.219	22.597	30.000
August	54.344	47.163	66.083	25.979	22.780	31.498
September	53.290	48.680	68.515	24.260	23.591	32.584
October	50.654	49.385	67.855	23.199	23.925	32.361
November	49.082	51.714	.....	22.703	25.094	.....
Dec.	49.375	54.971	.....	22.900	26.373	.....
Year	54.811	49.684	.....	25.314	23.675	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1915	1916	1915	1916	1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.167
Feb.	14.394	26.440	63.494	102.667	*	133.167
Mar.	14.787	26.310	66.152	107.714	*	136.000
April.	16.811	27.895	75.096	124.319	*	137.389
May	18.506	28.625	77.600	135.457	*	152.522
June	19.477	26.601	82.574	112.432	95.333	137.455
July	18.796	23.865	76.011	95.119	91.409	125.500
Aug.	16.941	26.120	68.673	110.283	82.333	126.304
Sept.	17.502	26.855	68.915	113.905	85.250	134.071
Oct.	17.686	27.193	72.601	122.750	88.000	142.523
Nov.	18.627	.....	77.744	.....	93.273	.....
Dec.	20.133	.....	80.773	.....	100.430	.....
Year	17.275	.....	72.532	.....	.....	.....

Tin	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	50.741	180.141	193.609
April	47.884	51.230	166.225	199.736
May	38.790	49.125	162.675	196.511
June	40.288	42.231	167.636	179.466
July	37.423	38.510	167.080	168.357
August	34.389	38.565	151.440	169.870
September	33.125	38.830	152.625	171.345
October	33.080	41.241	151.554	179.307
November	39.224	.....	167.670	.....
December	38.779	.....	167.000	.....
Av. year	38.590	.....	163.960	.....

Lead	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.246	3.718	6.164	19.122	31.988
March	4.053	7.136	3.997	7.375	21.883	34.440
April	4.221	7.630	4.142	7.655	21.094	34.368
May	4.274	7.463	4.182	7.332	20.347	32.967
June	5.932	6.936	5.836	6.749	25.170	31.011
July	5.659	6.352	5.531	6.185	24.611	28.137
August	4.656	6.244	4.520	6.088	21.946	29.734
September	4.610	6.810	4.490	6.699	23.151	30.786
October	4.600	7.000	4.499	6.898	23.994	30.716
November	5.155	.....	5.078	.....	26.278	.....
December	5.355	.....	5.266	.....	28.807	.....
Year	4.673	.....	4.567	.....	22.917	.....

Spelter	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb.	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	16.846	8.360	16.676	44.141	95.048
April.	10.012	16.695	9.837	16.525	49.888	99.056
May	14.781	14.276	14.610	14.106	68.100	94.217
June	21.208	11.752	21.038	11.582	100.614	68.591
July	19.026	8.925	18.856	8.755	97.250	50.750
Aug.	12.781	8.730	12.611	8.560	67.786	51.587
Sept.	13.440	8.990	13.270	8.820	67.841	52.095
Oct.	12.800	9.829	12.596	9.659	66.536	54.159
Nov.	15.962	.....	15.792	.....	88.409	.....
Dec.	15.391	.....	15.221	.....	89.400	.....
Year	13.230	.....	13.054	.....	67.553	.....

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.16	13.45	18.93	13.90	19.51
March	14.55	21.81	13.45	19.20	13.95	19.45
April	14.55	21.65	13.45	18.95	13.95	19.45
May	14.61	21.78	13.60	19.11	13.83	19.58
June	14.70	21.95	13.67	18.95	13.77	19.34
July	14.94	21.95	13.91	18.95	13.68	19.20
August	16.01	21.95	15.31	18.95	14.75	19.25
September	16.86	22.88	15.95	19.58	15.70	19.53
October	16.95	24.61	15.96	21.26	15.80	21.51
November	17.57	.....	16.47	.....	17.20	.....
December	19.97	.....	18.44	.....	18.95	.....
Year	$15.82	.....	$14.76	.....	$14.95	.....

‡ As reported by W. P. Snyder & Co.